Jack of all Animation, Master of Hybrid Practices through Experimentation with 2D and 3D Aesthetics

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Abstract

Animation has enabled the ability to tell stories through personal characters with intentions and varying personalities, allowing the creator to take complete control of their alternate universe (Besen & Hallett, 2008).

However, the issue is not just understanding the fundamental principles of character animation but expanding the approach within digital software to extend one's boundaries (Furniss, 1998). Applying an animation technique known as rotoscoping to trace realistic live-action footage can limit the creative potential of 2D animation (Luz, 2010). However, rotoscoping with 3D elements could form a different outcome and boost artistic decision-making.

This research will be conducted by creating an animation trailer implementing 2D characters in computer-generated environments (CG). The combined use of practice-led and action theoria methodologies is used to explore various visual tests for analysis and reflection. The animation trailer will be achieved using pre-visualisation (previs) to explore ideas and conceptual thinking, mind mapping to link and investigate keywords throughout the research process, and pencil tests/thumbnails for 2D animation assistance.

The significance of this project will explore the efficiencies and considerations of applying a 3D rotoscoping element to live-action, motion capture and keyframe animation as a basis for creating 2D character animation.

This thesis focuses on hybrid animation, combining 2D and 3D art styles (O'Hailey. 2010) and what this hybrid form can achieve by tracing over different types of media. This explorative research will be experimented with rotoscoping 2D animation over 3D variables to understand successful drawing potential.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

_____ _____17/10/2022

Signature Date

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Chapter 1 Introduction

Since its modern conception in the late 1800s, animation has evolved stylistically and technically to express the animator's perspectives, messages and qualities conveyed within their artistic expertise. Over time, animation has developed from traditional practices involving pencil and paper to those using celluloid and ink to more digitalised workflows incorporating computers, digital pens and tablets (Macdonald, 2016).

The use of computer digitisation has led to creations produced using hybrid animation, the 'combination of two-dimensional (2D) and three-dimensional (3D) animation media' (O'Hailey, 2010). This type of visual language to create moving images dominated visual culture through conveyed hybrid practices in works such as animations, commercials and music videos (Manovich, 2007), allowing the use of hybridity within an artistic view to be significant within the present-day. With the continuous development of the computer, many designers/animators must shift their technical skills from paper to screen for industry purposes (Muratovski, 2010). However, it is possible for animators primarily focused on 3D animation to use their skills within 3D software to engage with other styles of animation. Within the hybrid context of 2D character animation in computer-generated (CG) environments, it can be challenging to synchronise 2D/3D styles without clearly referencing how the 2D animated character would be perceived inside the CG space. This research will examine a practice known as rotoscoping, a cinematic process that involves drawing or tracing footage of real actors to generate believable movement for 2D characters (Cartwright, 2012). This research employs a digital variation known as 3D rotoscoping (3D assets as references instead of live-action) to help explore creative outcomes.

This thesis explores the potential for 3D rotoscoping to assist 3D animators with creating 2D character and environment animations.. Although it has been stated that rotoscoping tends to limit the creative potential of animators (Luz, 2010), it may be possible to implement 3D assets to benefit the drawing of complicated perspectives. Applying this version of rotoscoping can create clearer 2D drawings and assist with visual interpretation of space. This project will experiment with rotoscoping elements through various forms of media, such as live-action, keyframe animation and motion

capture. The three forms of media listed will be the focus points to trace over to inform 2D animation development and identify the efficiencies and difficulties of creating 3D rotoscoping in each context. Using each animation media and its explorative outcomes will inform the 2D movement within my movie trailer for a short film titled, *The Final Zenith*.

Researchers have found that applying rotoscoping elements to 3D animation rather than actual humans increases an animator's control (Syarifuddin & Lucas, 2021), allowing this thesis to explore potential rotoscoping processes with CG assets, not just live footage. The technique of digital rotoscoping can be used within all major 3D animation software. However, this research will undergo its investigation using Maya (3D) and Adobe Animate (2D) to find the potential use of applying 3D character references to benefit 2D animation control. Following a 2D/3D hybrid process for character development will hope to support further the proportional and anatomical drawings of the 2D character within a computer-generated world.

The main objective of this research project is to explore and examine 3D rotoscoping to create clear CG character references with minimal effort to strengthen the development of drawn 2D animation. These goals are not necessarily about creating new and modern technologies to invent new software but rather using what is available to refashionan existing process (Bolter & Grusin, 1999). There is a variety of information regarding various rotoscoping approaches and how they function within animation. This research will ultimately use the different types of digital media (live-action, motion capture and keyframe animation) to analyse each outcome and what each personal exploration can provide for 2D drawing support.

1.1 Research Question

The main purpose of this thesis is to answer the research question: to what extent can the technique of 3D rotoscoping (drawing over rough 3D character references) be used as a means of supporting an animator's artistic ability to better craft 2D animation within a 3D hybrid space?

Chapter 2 Literature Review

The following chapter examines the case studies of past work/knowledge regarding the area of rotoscoping to discuss any partial or distinctive features to develop further insight into the research.

2.1 *Koko the Clown by* the Fleischer Brothers (1933)

A historic animation created by the Fleischer Brothers features the iconic 2D character Koko the Clown from the series *Out of the Inkwell* (Bray, Fleischer & Fleischer, 1918). The animation of Koko is significant because his character was animated using the traditional technique of rotoscoping, drawing directly over the footage via paper or celluloid (transparent paper), thus creating a sense of realistic movement. Figure 1 sheds light on the similarities between the human actor and Koko the Clown.

Figure 1. An example of the live-Action reference, left, used to drive the movements of Koko the Clown, right (Heroderith, 2017).

The introduction of the rotoscope technique to animate Koko the Clown enabled Flesicher's character to perform realistically with human-like qualities. However, it has been stated that rotoscoping (alongside motion capture) can be seen to have creative limitations on animating purely on a mere representation (Luz, 2010). This statement by Luz suggests it is an inefficient way of expressing movement by cutting corners lacking artistic value and credibility by tracing the portrayal of characters step by step. It has also been argued that rotoscoping expresses a controversial aesthetic: does it classify as animation or as an amalgamation of actions (Bruckner, 2015)?

For an animation to be successful and convey plausible movement, Disney's Twelve Principles of Animation were established and followed to shape and validate 2D actions (Johnston & Thomas, 1995, p. 47). The inclusion and execution of the twelve principles allow for further refining and enhancing the motion and energy of 2D characters throughout drawn sequences. Actors can inspire the movements of characters regardless of their distinctive or subtle differences in proportions, size, and scale to help develop ideas for 2D animation.

2.2 *Snow White and the Seven Dwarfs*, Disney (1937)

In the film *Snow White and the Seven Dwarfs* (Disney et al., 1937), the company Disney used a real-life actor/performer as the blueprint for Snow White's human-like movements, giving the character realism throughout the entirety of the film (Figure 2). During the earlier stages of animation, the rotoscoping technique was used to express the most natural form of movement onto a character at the time (Ward, 2006). Despite that being the case, a contradiction stated that it was impossible to entirely make the protagonist Snow White follow the realistic movements from the human actor reference and look just as believable (Lee & Madej, 2012).

Figure 2. The making of Snow White, the performer of Snow White on the left and on the right, the final rotoscoped look (Dis Avenue, 2017).

To intrigue a contemporary audience, it is necessary to push the movements of the 2D characters to fit their stylisation. However, the movements themselves, based on actual life actions, can be used to understand movement for animation better but cannot be entirely copied as it can limit the animator's intentions and creativity (Pardew & Wolfley, 2005). The *Film Snow White and the Seven Dwarfs* has shown that rotoscoping techniques could influence plausible animated movement to a certain degree however can indicate a lack of the animator's creative intentions.

Today, rotoscoping is not an obsolete technique for character animation; it can be best used as a movement indicator rather than as a tool to rely on to produce movement/motion. Based on live-action references, it is up to the animator to understand and interpret what movements/actions can be pushed and manipulated for a given 2D character.

The ability of an animator to understand which of their character's movements could be pushed and emphasised while using the rotoscoping technique will depend on the current skill and experience of the animator. As the animator's skills develop, rotoscoping could become a tool to help them visually capture an inspired motion. Instead of tracing the actor, the animator may use it as a guide to remake rather than copy its actions.

2.3 *A Scanner Darkly* (2006)

Another case study involving rotoscoping techniques over live-action is the 2006 film *A Scanner Darkly*. Directed by Richard Linklater (Mcbay et al., 2006), this film uses a digital strategy based on the rotoscope, known as Rotoshop (Figure 3). This software, invented by Bob Sabiston allows an animator to not necessarily draw every single line when tracing over the live-action characters because the software has an 'interpolating feature' that allows the computer to assist animators with the line work (Ward, 2012a). Rotoshop can help the animator apply a rotoscoping technique within a scene with more time efficiency. It was noted when making this film that animators used the Rotoshop software to create and examine a 'troubled' like identity/effect associated with the characters in *A Scanner Darkly* (Ward, 2012b).

Figure 3. The use of Rotoshop Forming a particular traced aesthetic onto the actor Keanu Reeves in A Scanner Darkly (Trailers, 2014).

Although *A Scanner Darkly* presents the human actors themselves in the final product, the use of Rotoshop forms a particular dreamlike aesthetic to set the tone and mood of the film. The film shows a different approach to Snow White in which the actors are rotoscoped, but their identities/physiques remain the same. In contrast, Snow White was a fictional character with her movements replicated by a performer. However, the reliance on rotoscoping live-action media has been argued to cause visual confusion, generating a sense of uncanniness as the realistic movements are visually altered in a stylised world (Honess Roe, 2012). Honess's way of thinking helps us understand that rotoscoping elements can be applied to life references but only to an extent before the mixture of realistic movements and stylised characters tend to clash rather than cooperate. Ultimately, these three case studies have helped elaborate on the creative potential and limitations of the traditional tracing technique over live-action actors.

2.4 *Freak of the Week Animation* (2014)

Swedish rock band Freak Kitchen's official music video *Freak of the Week,* directed and produced by Juanjo Guarnido (2014), shows several scenes of 2D characters established within a 3D environment. Throughout production, the animators used

rough 3D rigs manually animated through basic keyframes and represented closely, but not entirely, the designs of the 2D characters drawn in TV Paint, their chosen 2D software (shown in Figure 4 and Figure 5). Using these roughly made 3D rigs, they could capture the essence of an animator's 2D style from any camera angle/perspective they saw fit. The animators could transfer the proportions, scaling, and depth of the 2D characters onto the CG references as they operated within the moving 3D space.

Figure 4. 2D character from Freak of the Week not drawn over the 3D reference completely (Bizat, 2017).

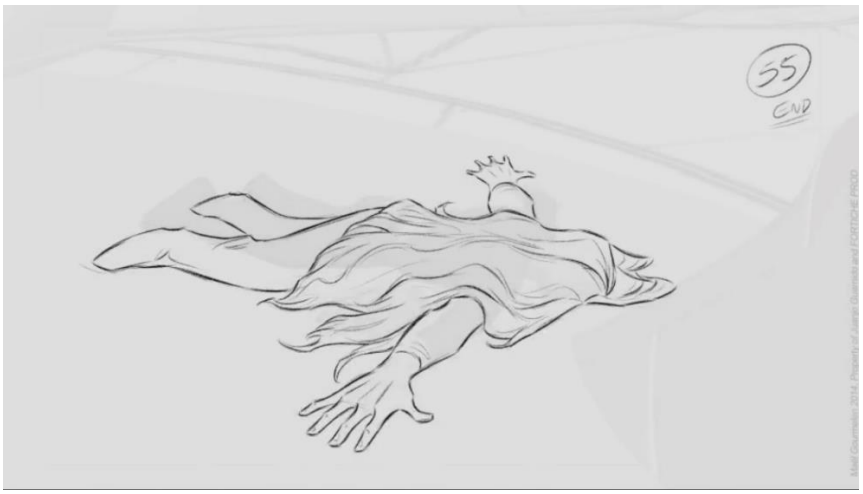

Figure 5. 2D Character drawn over 3D reference but not entirely shown in the positioning. (Gourmelen, 2016).

The *Freak of the Week* hybrid animation plays an essential role in connecting itself to the concept of 3D rotoscoping due to the significant use of 3D rig references rather than live-action references. Their behind-the-scenes video shows how the 3D rigs drove the 2D characters during the production phase (Guarnido, 2014). Animators would draw over the rig in 2D animation software, assisting the animator in how the 2D character could operate, considering it is a flat entity positioned in a CG world with depth and dimensionality. However, a significant aspect that was observed while viewing the breakdowns of this animated short film was how the animators only used certain parts of the 3D rig when animating the 2D character layered on top of the 3D reference. As a result, the final 2D outcome was similar but not completely reliant on how the 3D rig performed during slow/fast camera shots. In the behind-the-scenes video, co-producer Pascal Charrue mentions that motion capture was not used due to its realistic nature and would require extra work from the 2D animators to exaggerate and enhance all the character's actions. This case study has shown 3D character rigs to be used as 2D character templates. It is also wise to review the shot beforehand to see whether keyframe animation or motion capture would be applicable to a particular scene (Izani et al., 2003). Ultimately, it is the animator's role to determine how detailed or specific the rig needs to be to capture the desired reference of the 2D character model.

According to Syarifuddin and Lucas (2021), applying 2D character animation through rotoscoping elements derived from 3D playblasts (low-resolution exported videos from 3D software (Rodriguez, 2012), sacrifices some aspects of realism for more creative potential. Syarifuddin and Lucas's discussions suggest that the outcome of rotoscoping in a 3D approach forms more creative development, supporting the concept of drawing 2D animation based on a CG character template.

The ideas and insights derived from the *Freak of the Week* animation case study and the literature examined influence this thesis in classifying a sense of potential landmarks. For example, these features can be certain things unique to the character that may be necessary to be captured on a rough 3D rig template, such as facial features etc. The significant difference of this research is exploring each creative outcome to use 3D character references to support 2D characters of any degree of complexity quickly and efficiently, regardless of design. Considering the subjective

nature of implementing original characters, other animators may have unique designs of more complex apparel or accessories. Animators may want to keep the 2D aesthetic due to its dominating strength in expressiveness (Rall, 2017) or preferred aesthetic for their chosen subject matter (O'Hailey, 2010).

2.5 *Where the Wild Things Are by John Lasseter* (1983)

During the 1980s, famous animator John Lasseter created an innovative test for the film *Where the Wild Things Are* (Gorkab, 2017), which features 2D character movements within a CG environment captured from still and moving camera shots. The breakdowns of the animation test *Where the Wild Things Are* also featured fundamental 3D shapes representing a boy chasing a dog in his bedroom (shown in Figure 6). The early test incorporated these 3D shapes moving throughout a CG environment. The significant aspect of this rough 3D test was the linear and static movements/rotations of the 3D shapes giving very little information on how the character will operate and its lack of similarities to the representation of the 2D drawings. The animators refined the featured illustrations of the boy and his dog later in the production process (Figure 7). the animation scene shows the boy jumping on a bed and chasing the dog down the stairs. Lenburg (2012) stated that due to financial reasons, this project was cancelled. However, as technology had progressed from when this test was made, animation software and computers are more accessible and affordable, including software access for art students (Harris, 2014). Technological advancements can help form opportunities to use hybrid combinations of different animated styles within a particular scene, leading to more intriguing animations by other animators with their signature visual languages. Considering the use of 2D and 3D animation aesthetics, regardless of the current skillsets and portfolios the animator has, they can employ the hybrid aesthetic not necessarily for visuals but used in the sense of a technical reference tool to boost 2D animation control. In the case study *Where the Wild Things Are*, the use of 3D references demonstrates that the low-resolution shapes of the boy and the dog were not heavily adhered to when creating the 2D drawings. Presumably, this is due to the simplistic nature of these proxy shapes as they interact with each other during the chase scene.

Figure 6. Preview of John Lasseter's first test featuring basic 3D shapes showing a simplistic boy on the end of the bed (Kurtori, 2006).

Figure 7. The final look of John Lasseter's animation test on top of the 3D reference (Gorkab, 2017).

Examining the animation test *Where the Wild Things Are* by John Lasseter allows further understanding in establishing the potential of artistic execution by the 2D animator derived from very rough 3D shapes representing much more complex characters. Despite the 3D reference lacking character detail and animation principles,

this could be used as a time-efficient way of capturing the necessary information of an established 2D character from a 3D perspective. However, the 3D references are too vague and simplistic to show a sense of the final character being expressed within 2D animation software. Although this was an innovation of using 3D elements when Lasseter's animation test was made, it could be possible to add more complexity and control to the CG references to assist the design fidelity of the 2D character. 3D animators who struggle to draw in 2D frame-by-frame in CG environments can apply 3D rotoscoping to several 3D mediums, such as keyframe animation or motion capture.

2.6 *Jaguar McGuire* (2009)

A case study known as *Jaguar McGuire* (JaguarMcGuire, 2009) revealed several similarities to John Lasseter's animation test titled *Where the Wild Things Are*. Animation professor Tina O'Hailey created this hybrid animation with a group of her students. This animation took place with the protagonist Jaguar almost covered entirely in a body cast resulting from a high-impact motorbike stunt. This character has a hybrid design with the body cast created in 3D software, whereas the parts of Jaguar's anatomy not covered by the cast are drawn in 2D. According to O'Hailey, during the development of Jaguar, they used low/high-resolution models of the character's face (displayed in Figure 8 and Figure 9). The low-resolution model was used to establish the reference for positioning Jaguar's face throughout the film. In contrast, the high-resolution model was used to 'allow more perspective help for the 2D animators' (O'Hailey, 2010). O'Hailey's approach to hybrid animation mentions how Jaguar's high-resolution model had benefited the 2D animators in drawing the stylisation of the face and ears. If the high-resolution model was not followed, there could have been complications animating the 2D drawings within a 3D space without a means of proper referencing.

Considering *Jaguar McGuire*'s character design, the structure clearly has limited articulation, as shown during the 3D reference. The conceptual design of Jaguar consisted of a low-detailed 3D object representing the body cast which covers most of the character. The body cast is stiff and rigid, giving a more detailed and accurate reproduction of Jaguar's restricted movement. The body cast's simplistic design and lack of movement resulted in minimal 3D animation control.

A significant aspect of this case study is that it shows the use of moulding the 3D elements to express a more accurate representation of the final 2D character, similar to the *Freak of the Week*'s 3D models. *Jaguar McGuire,* in particular, can obtain animation control from 3D assets/references, allowing for easier visual interpretation and improving 2D animation expressions and principles.

Jaguar McGuire's creative approach helps examine possible processes and considerations when applying 3D rotoscoping or similar animation techniques and referencing them from 3D rigs to finalise the moving 2D character. Doing so creates opportunities to add stylised or realistic movement, which can affect the specific design of the 2D character depending on the animator's vision.

Figure 8. Preview of Jaguar McGuire's roughly modelled head on an animated body cast with the storyboard preview (JaguarMcGuire, 2009a).

Figure 9. A more defined model of Jaguar McGuire's face presenting a more detailed face for the final 2D drawing (JaguarMcGuire, 2009b).

2.7 3D Rotoscoping with Grease Pencil by Team Miracles (2020)

Animator Shenuka Corea from the game design studio, Team Miracles uploaded a YouTube video showing how she rotoscoped over a 3D character using the Grease Pencil tool in the open-source 3D software Blender (Miracles, 2020). The Grease Pencil tool was initially used for note-taking and rough sketches but later became a flexible way to produce 2D animation within Blender (Blain, 2021). The process shown in this case study involved a basic 3D character rig with minimal features imported from a Mixamo, a motion capture repository website (Mixamo, 2015). Corea used a live-action image found online as a reference to replicate the pose onto the 3D rig. The image used was a man who performed an energetic pose mid-jump. Corea's 3D character showed little movement throughout the scene and was based on a particular pose (Figure 10). Although the pose did not involve much clean-up or exaggerated adjustments, the rig was chosen as a prominent reference for her 2D drawings. Throughout the setup process, a 3D sword was parented to the 3D character's hand, which helped guide the animator to draw the sword accurately and consistently throughout the moving scene.

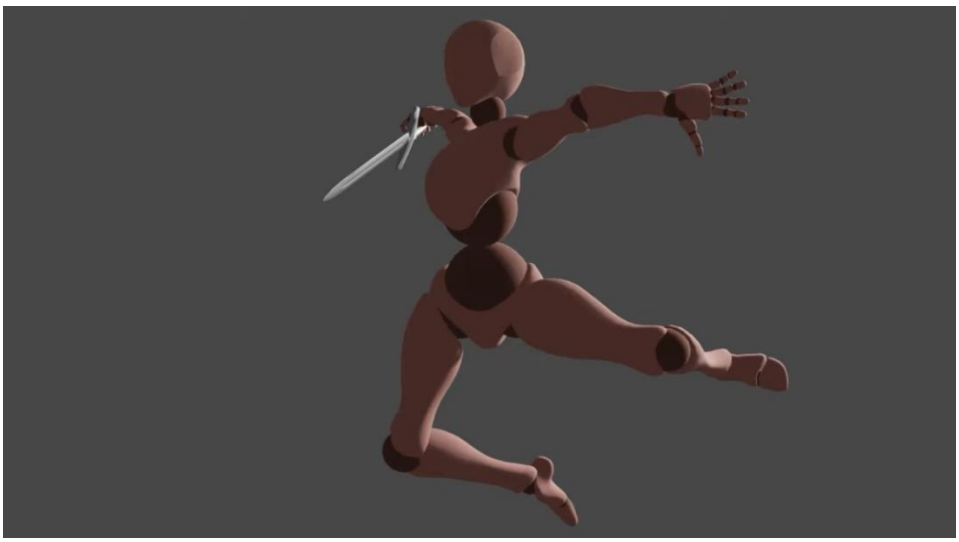

Figure 10. 3D rig Imported from Mixamo, adjusted to display a dynamic pose in Blender (Miracles, 2020).

Corea's work in 3D rotoscoping shows overlapping animation on the 2D character's outfit and hair movement. However, it appears to lack a sense of exaggeration and anticipation within the action as the character seems to be somewhat frozen/still throughout the moving sequence. This lack of energy is due to the reliance on the 3D reference slowly transitioning over time and not adding much expressiveness to the character's final motions (Figure 11). According to Norman McClaren's definition of animation:

> Animation is not the art of drawings that move but the art of movements that are drawn; What happens between each frame is much more important than what exists on each frame; Animation is therefore the art of manipulating the invisible interstices that lie between the frames (quoted in Furniss, 1998, p. 5).

The reliance on copying the 3D reference pose does not add much life to the performance itself but does establish a sense of dimensionality to the 2D drawings. The use of the CG reference did help add a smooth sense of depth to the 2D character's flatness in Figure 12 to express smooth changes in perspective as the shot moved around the character.

Figure 11. Shenuka's 2D character drawn with the Grease Pencil over the 3D character from Mixamo (Miracles, 2020).

Figure 12. The 2D character is finalised with added colour and shading (Miracles, 2020).

It is shown throughout the breakdowns in this case study that Corea's 2D character design was more complex than the 3D reference, which had no distinctive features. Corea demonstrates how the reference can help an animator understand where certain things are generally located without needing specific objects to replicate typical features on a person, such as ears, nose, or eyes. However, in terms of visual accuracy, it may be necessary to add simple shapes to represent certain features if the character

in choice is unique or the animator has different artistic skill levels. Corea's outfit design for her 2D character is from a concept drawing she made previously shown in the video. Her creative abilities can animate stylised characters with a draped costumes through a moving 3D reference that contain no specific visual assets that represent the majority of a character's design. Although it is possible to not have an identical reference for the 2D concept, it can be difficult for 3D-based animators with varying 2D skills when they encounter inconsistencies in 3D character references/designs, as this relies on them being able to artistically fill in the gaps. Considering that different animators can vary in skill and experience in character performance (Beiman, 2016), it would be beneficial to create a more specific character template to show the rough layout of the character.

2.8 Rotoscoping Over 3D Reference by Paul Johnson (2014)

Another case study featuring rotoscoping over 3D reference is Paul Johnson's example from his YouTube channel that discusses how he uses rotoscoping to benefit his cockpit scenes for a mecha-anime style animation (Johnson, 2014). The breakdowns in this case study start with creating a rough foundation for a cockpit environment with a 3D character sitting in the middle made up of basic imported shapes representing the limbs, torso and head (Figure 13). Once the scene was finalised, Johnson drew his chosen character over the rough 3D reference throughout the sequence (Figure 14), showing little movements of the head-turning. It is clearly shown in the final drawings (Figure 15) that the 3D rig is driving the 2D character while not following the proportions of the reference due to design differences.

Figure 13. Paul Johnson's rough 3D character built from simple shapes with minimal detail (Johnson, 2014).

Figure 14. 3D reference was used as the basis for the stylised 2D pilot (Johnson, 2014).

Figure 15. The final 2D animation with added colour and shading (Johnson, 2014).

The nature of the character sitting stationary in the cockpit shows a more focused still scene as the camera moves towards the eyes of the character. Using lesser movement forms a similar approach to the *Jaguar McGuire* case study, as the minimal use of movement and articulation was factored into the nature of the animation's narrative. Compared to the *Freak of the Week* animation and the video by Team Miracles, showing full-body character performances requires more consideration of the exaggeration and use of energy within the animation's specific circumstances.

This case study by Paul Johnson and the previous case study by Corea from Team Miracles shows very similar approaches using 3D rotoscoping tools within their chosen digital software and using keyframes to establish the movement. Both case studies show the ability to use 3D character templates with minimal detail to help get a general idea of how to draw the 2D character on top despite having visual differences (such as Johnson's 3D reference not wearing a cap to represent the 2D pilot's cap). The talent of both animators to transfer the design and movements of their chosen 2D characters and create a moving animation that expresses a more dimensional perspective is shown. However, depending on the movements and how much the cinematography is moving/rotating within the CG sequence, the inaccurate nature of the used reference can be difficult to use and perhaps benefit from adding specific details to the 3D rig. The use of particular character references appears in the *Freak of the Week* case study, with their 3D character rigs showing a more similar makeup to the finalised drawn version. But what needs to be considered is that the poses and the movement may need to be adjusted/pushed to avoid the duplication of the reference material, as it is not the final look but an idea or inspiration.

The case studies have shown that the concept of 3D rotoscoping can be achieved from varying types of software, such as Maya, Blender, TV Paint and Adobe Animate. The flexible use of this technique can allow animators focused on a particular program to explore this approach further to generate creative outcomes, allowing this technique to be adapted.

Chapter 3 Methods/Methodology

3.1 Methodology

The outcome of this research is based on creating an animation trailer involving 2D characters in CG environments. Examining the use of 3D rotoscoping and similar techniques will provide an answer to the research question: to what extent can the technique of 3D rotoscoping (drawing over rough 3D character references) be used as a means of supporting an animator's artistic ability to better craft 2D animation within a 3D hybrid space?

This research will be undertaken by the methodological approach of practice-led research to discover new knowledge for practice and understand its creative significance (Candy, 2006). However, this approach may not be enough to drive the project of knowledge gathering but could potentially be supported by the introduction and use of an action research approach. An action research methodology allows for reflection and exploration of the individual processes for 2D development to further expand on positive and negative reflections to reach a particular outcome or result (McNiff, 2013). Ultimately, the animation trailer's processes will be tested and push its boundaries due to the hybrid use of multiple methodologies.

Combining methodological approaches and linking the connection to action research has led to a hybrid system known as 'action theoria' (Harty & Sawdon, 2016). Applying this multimethodological approach combines the use of action research (regarding experimentation and reflection) with the help of theoria, which according to Nicholas Davey, allows for focusing on a particular subject matter and linking it to practice (Macleod et al., 2005). Theoria can also synthesise conceptual material within one area of enquiry that can assist general practice. This perspective on action theoria can allow animators to experiment and go beyond what has been established within the subject matter of their work, thus refining their searches and explorations of a particular experiment or idea.

Hybrid methodologies enable further research and investigation, given that multiple methodologies can be used within a singular paradigm (Mingers & Brocklesby, 1997).

The use of a hybrid methodology allows this research to delve into alternative animation processes, giving leeway to finding specific information based on these topics and narrowing the subject matter down to reveal, for example, the technique of 3D rotoscoping.

3.2 Previsualisation

For the starting point of the animation process, the previsualisation (previs) workflow is implemented as one of the critical methods which intertwine with the methodological approach of action theoria. Animators use previs to generate ideas/characters of interest for the development of the animation. Previsualisation helps establish major decisions and finalisations of how the project will function, essentially the building blocks of an animation/film (Paquette, 2013). During the previs phase, various iterations and brainstorming sessions are involved in helping drive the animation, develop ideas, give direction and record them. Previs can create rough 3D assets/sequences to help capture specific ideas or elements. To form the blueprint and essence of a story with purpose and narrative, the use of previs enables the explorative gathering of ideas, concepts and research before using them in the production phase (Selby, 2013). The use of previs can also help generate and change conceptual storyboards, structured drawings representing visual script ideas (White & Spencer, 2013, p. 255), and animatics (storyboards in video form) (White & Spencer, 2013, p. 293) to allow the structuring of the animation.

Once the conceptual designs, such as the characters, locations, and plots, have been captured and finalised, the previs phase allows the overall portrayal of the film or animation to express the animator's ideas clearly. The assets created are then examined in pre-production as to how they could best function aesthetically before the production phase. Animators can also use the previs method to experiment with and explore a variety of tests, such as good camera shots to emphasise the message or story and establish any additional visual elements.

This animation trailer was structured using a hybrid approach during the previs phase. It involved the creation of 2D characters (from concepts to final designs) and 3D assets (3D environments such as bedroom environments, mountain terrains and sci-fi labs etc.). Alongside the process of creating the assets, which included rough note-

taking and sketches to help form a baseline, I (as the animator/director for this project) was able to generate ideas to develop a story for the animation trailer.

3.3 Mind Mapping

Mind maps were introduced to generate specific ideas and examinations that could be missed or forgotten throughout this research process, including general key terms to help refine the findings for this thesis. This method of brainstorming is known as a visual thinking tool that combines and links conceptual thoughts, ideas, and critical components within a particular area of research (Hanington & Martin, 2012). The mind mapping method will allow the branching of conceptual ideas and existing phenomena within a chosen context. Using mind maps will link several aspects, including topics, terms, and case studies, towards an established question I have identified during the research process. Mind maps were introduced to link keywords and expand subjective knowledge referenced to terms limited to 2D, 3D, and hybrid animation shown in Figure 16, which later focused on motion capture, keyframe animation and live-action.

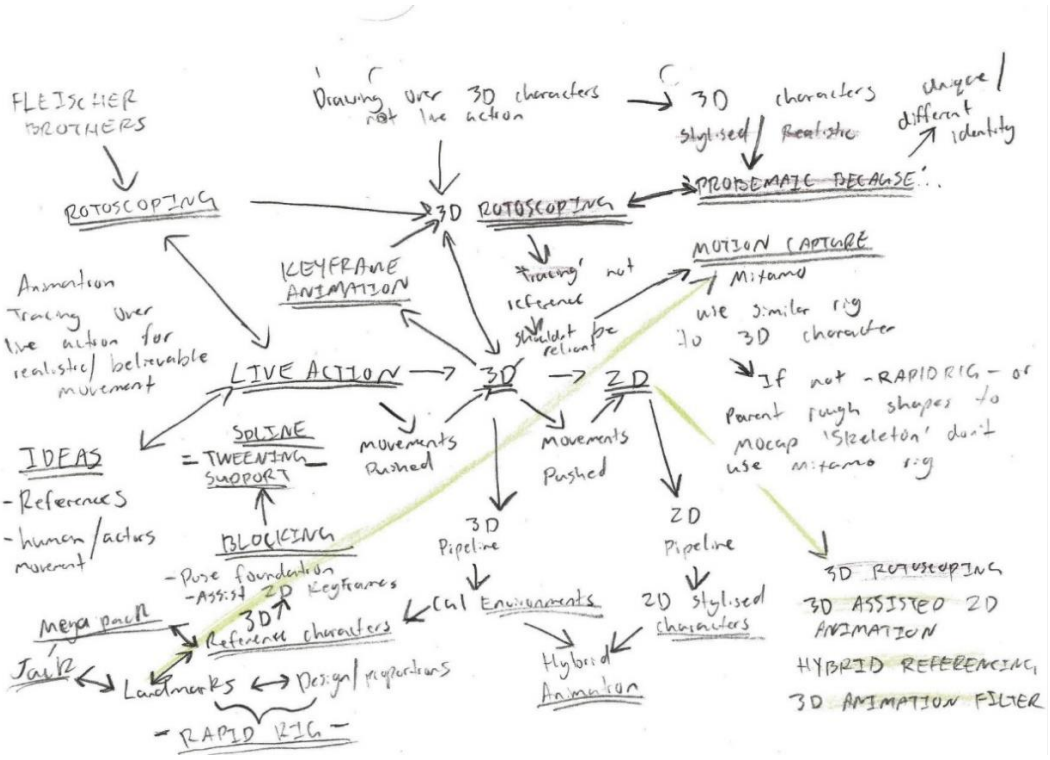

Figure 16. A rough mind map Identifying potential areas for further research.

Following the keywords previously listed in the mind map diagram (Figure 16) helped shape the findings and identified gaps within this research process. This brainstorming method was also used to find certain case studies (found in the literature review). Mind mapping allows the intertwining of information for aspects such as visual processes, aesthetics and existing works. This method has led to a more refined search for potential academic findings and validation. Implementing and establishing these terms to gather more accurate readings and research would mould my findings, enabling me to examine further and investigate the research question.

3.4 Study of Poses (Thumbnails/Pencil Tests)

Finally, thumbnails and pencil tests were introduced throughout the animation production process to add plausible movement to the 2D characters to study and break down poses from real-life references. Using thumbnails allows animators to break down their reference footage of either themselves or another actor to examine key poses within footage through exploratory sketches to push any animated performance (Osborn, 2016). Using thumbnails enables an animator to sincerely express imaginative ideas when pushing the poses of their stylised characters based on something from real life. According to Pardew and Wolfley (2005), exaggerated cartoon animation has a basis in real-life motion.

Thumbnails were implemented during the pre-production phase of the animation project to capture an idea that comes to mind and record it visually (shown in Figure 17), whether it is a shot, character or pose. One of the benefits when working with thumbnails is that the ideas recorded don’t need to be finalised or refined but can consist of rough sketches/storyboards or basic stick figures to represent the characters (Webster & O’Reilly, 2006).

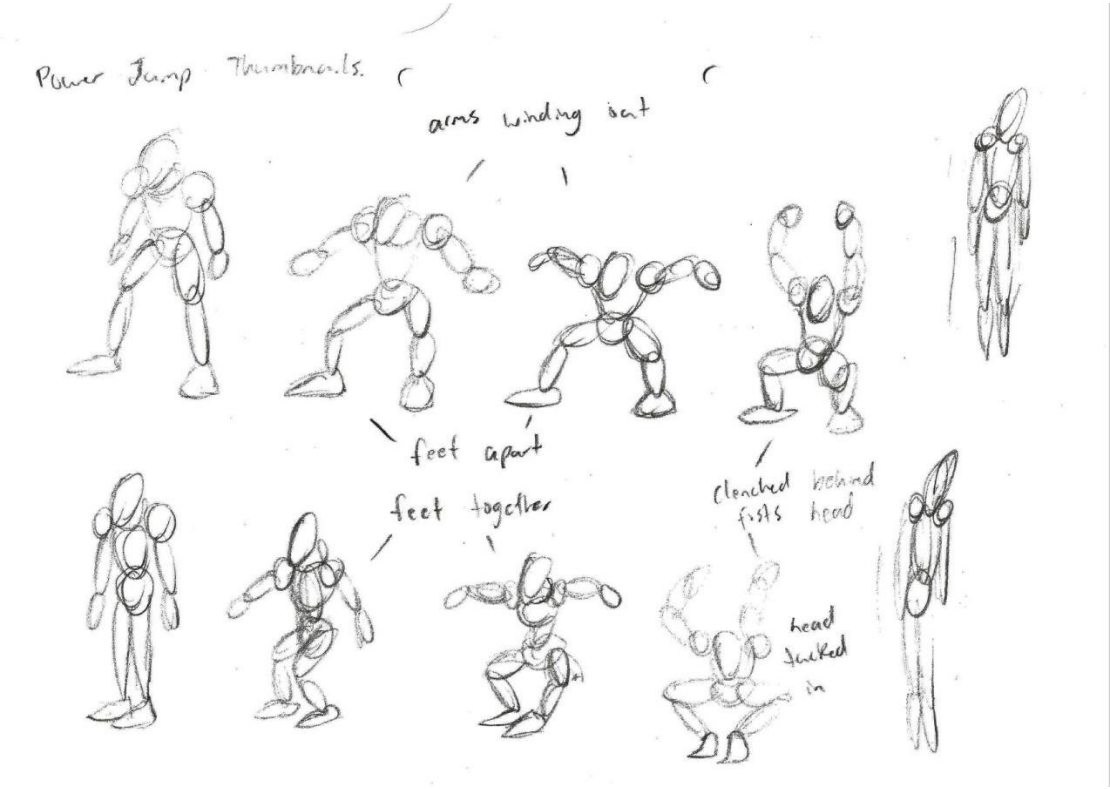

Figure 17. Rough thumbnails for an exaggerated power jump.

Initially, the use of thumbnails was used as a method to record an idea or sketch during the pre-production phase. But, it was later used as the foundation for 3D character animation to be adapted and drawn throughout the production. Thumbnails were employed as an assistive tool to push the poses and actions of a character within 3D software. This method helps visually display the basic movement for 3D characters used as digital references in computer software. Applying the visual support of the CG character based on the thumbnails can later be used as a reference to draw any established 2D character accurately. To an extent, thumbnails (working within a 3D environment) could be applied to still/moving digital cameras within the CG space, thus preserving the proportions and perspective angles of the 2D characters. Using pencil tests/thumbnails helped form inspirations and finalised ideas for the 3D character reference. Once the pencil sketches are applied, the poses/movements could be adjusted and manipulated for the final 2D drawings.

Throughout the production process, thumbnails took character expressions to a deeper level by giving depth through a mixture of flat pencil tests and 3D references.

Making thumbnails benefit the final animation requires analysing the drawn pictures or frames to make animations effective and stronger (Lee, 2012).

Using thumbnails helps establish an idea to create a particular animated scene to be recorded. Animators can use rough character sketches to visually study the subject's motion to exaggerate and stylise human character poses. Once the thumbnails contain a finalised idea for a particular scene, the pencil tests led the character's animated actions onto the 3D references. Applying the method of rough sketches helps support the drawing process in settings that involve moving or still cinematography within a CG environment.

Chapter 4 Discussions

4.1 2D Animation

The following chapter examines the uses of 2D animation to reflect upon the project experiments to answer the following research question: to what extent can the technique of 3D rotoscoping (drawing over rough 3D character references) be used as a means of supporting an animator's artistic ability to better craft 2D animation within a 3D hybrid space? Making an animated trailer is done to help serve as an answer.

4.1.1 Strengths and Limitations of 2D Animators

A primary strength of 2D animation (or, in other words, 'hand-drawn' animation) is its ability to provide complete control over the shapes that make up a character's design and allow for more vigorous expressions and stylisations with fewer technical software errors (Rall, 2017). The animation itself is driven mainly by the animator rather than the computer. However, 2D animation does have its limitations with the amount of labour needed to create and finalise a 2D animation due to its meticulous nature - e.g.: drawing a 2D character entirely and consistently from multiple angles (Du, 2021). In comparison to 3D software, the animator does not necessarily need the character to be drawn entirely in each frame but establishes a CG character with keyframes and uses the computer and their creativity to manipulate those keyframes to express how the character would move. Although 2D animation has varying labour and style differences compared to its 3D counterpart, they both have the essential demand from the animator, which is to use creative thinking to express a powerful character.

4.1.2 The Need for 2D Animators

2D animators will need specific skills and portfolios for their desired roles in commercial or independent productions. For the animation industry, a significant degree of artistic drawing ability is required for 2D animation, whereas in comparison to 3D animation, this is of less concern (White, 2006). Ultimately, within major commercial productions, multiple 2D animators or inbetweeners would work together, focusing on a single character or individual parts of a character, supported by animation supervisors to teach how the character should be drawn through basic

shapes **(**Winder, Dowlatabadi, & Miller-Zarneke, 2019). Larger production companies can involve an extra number of specified roles that work alongside 2D animators, including inbetweeners, animation clean-up departments, compositors etc.

In independent companies, animators may need to take several roles (such as authors, directors or storyboarders) depending on the staff numbers (Rall, 2017). The animator can obtain more creative freedom but requires a wide variety of skills to fill those multiple roles when following any 2D animation pipeline**.** Musburger states that if independent animators complete the work by themselves, the production process remains the same regardless of the complexities in animation production (2017). Musburger's discussion can shape the idea that 2D animators in independent companies may have limited resources and must follow specific procedures to achieve a satisfactory outcome. An example can be implementing model sheets to ensure the character template is shown finely through many angles/views to provide successful character drawings for the production phase. Depending on the circumstances of the production company, specific angles may be used to capture the character alongside action poses due to time constraints (Milic & McConville, 2006).

Another factor required for 2D animators is establishing spatial depth successfully within a 2D animation. According to Polson, legendary animation layout artist Maurice Noble focused on perspective and spatial depth to make a 2D world less flat and make compositions more interesting and dynamic to the viewer (2013). Animators can achieve spatial depth by forming straight perspective lines on the canvas to help the viewer focus on a particular object or thing, such as making use of the background, foreground and midground spaces or changing the sizes of certain elements depending on the location of the object. For a 2D animation that lacks dimension, applying perspective helps avoid the sense of flatness that can appear within the composition.

Noble, as a highly-trained 2D layout artist, shows the successful use of establishing depth within a 2D animation. However, I do not have the degree of skill to create successful perspectives entirely within 2D animation software, but I understand how it can be reached. Regarding Noble's approach to perspective, storyboard artist Mark Simon notes that the use of animation software Amino can 'place your 2D layers in a

3D space, allowing you to manipulate your camera throughout the third dimension.' (2013, p. 201)

Animation layout artist Noble and storyboard artist Simon helped me form the idea that although 2D animators can achieve depth and perspective within 2D software only, 3D elements can contribute to help resolve any difficulties of achieving successful animation depth. Within 2D software, establishing points and accurate proportions of objects need to be taken into account to emphasise the depth of the project's landscape and intrigue the viewer.

4.1.3 Drawing Style Development

The conceptual designs and stylisations of my 2D characters were inspired by my interests growing up, such as the style of the TV show Adventure Time (2010), which used solid colouring and simple designs (Figure 18). In the show, shadowing and colour blends appear on backgrounds and characters to an extent. However, in my own animation trailer, shadows are not fully implemented due to my lack of knowledge of successfully applying them to my artwork.

Figure 18. A snapshot of Finn, the Human and Jake the Dog in the Adventure Time intro, showing solid colouring and minimal shading (Network. 2016).

My drawing style used for my characters is mainly adapted from the Japanese anime My Hero Academia (2016), which inspired a more anime-like aesthetic with larger eyes and stylised hairstyles (Figure 19).

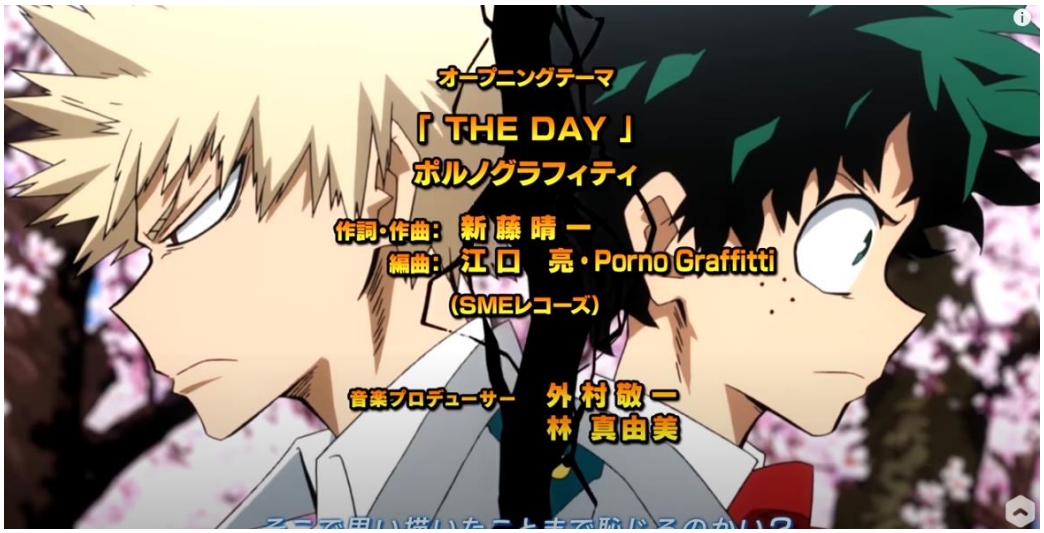

Figure 19. A snapshot of Katsuki Bakugou and Izuku Midoriya, drawn with large, stylised eyes and exaggerated hair (Animelab, 2016).

The character ideas and designs were also generated from various video games, such as the spikey outlines of Sonic the Hedgehog from the Mania Adventure Series animation (2018) in Figure 20 and the limbless design from Rayman (1999) in Figure 21. One of the ideas that influenced my style is having two characters with contrasting colours (hot and cold), which heavily influenced the use of colours on my characters to establish not only the differences between them but how they operate. Ultimately, I wanted to combine aspects that I liked from each of the listed inspirations and try to implement them into my work and successfully develop a similar artistic outcome for visual and narrative ideas.

Figure 20. Sonic the Hedgehog featured in the Sonic Mania Adventures Series (Hedgehog, 2018).

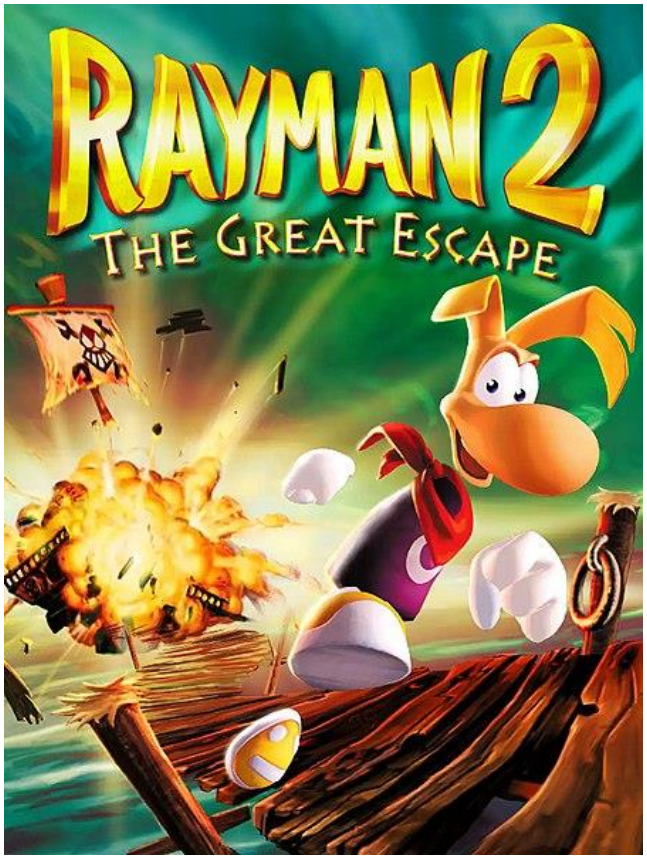

Figure 21. Cover photo for the video game Rayman 2: The Great Escape, from "Wikipedia Commons" by Davilon4, 2022.

(https://commons.wikimedia.org/wiki/File:Rayman_2_The_Great_Escape.jpg) CC by 4.0

My chosen style was the most comfortable and easiest way to produce 2D character animation at the time, but it was mostly my character designs that were adjusted over time (shown in Figure 22 and Figure 23). Ultimately my drawing style is derived from everything I have learnt so far with the current knowledge I obtained to try and form a narrative within a movie trailer. In other words, the more I practice, the more proficient I will be in developing my drawing style, which I can say for certain has areas of improvement for artistic/technical skill development. I wanted to implement similar approaches to colours and styles inspired by both Rayman and Sonic. Their features intrigued me because they operated with dynamic motions and energy within an animation/video game. I wanted to capture Rayman and Sonic's design elements and interpret those ideas into my character makeup through explorative drawings, such as my stylised video game characters following Rayman's limbless design and use of saturated colours shown in Sonic's design (Figure 24).

In my animation trailer, the characters are drawn with thick lines. I used this type of drawing style to make the 2D animation more vivid and stand out, inspired by the show Adventure Time. Using a thicker line stroke helped me establish my 2D characters more within a CG space, as they are my focus points. The use of thick lines helped establish the cartoon nature of my characters, emphasising the 2D style. However, throughout production, using thick lines at times made the drawings look rougher and not so refined, giving the characters a more sketchy-like style rather than a clean aesthetic.

In the future, I would improve my drawing style by adjusting the line work to achieve cleaner lines and improve the use of colour shading to achieve more intriguing art. I may use thick lines if necessary to experiment and ensure the lines are clear and vivid. In terms of design choices, I would develop new creations with the knowledge I gain over time to achieve a higher level of animation production and improve from old works.

Conceptual drawings/model sheets were made to form a basis for each 2D character featured in the animation trailer, so I could eventually incorporate rotoscoping elements into the character animation. These drawings established the final proportions and designs of varying 2D characters developed during the previs process

(Figure 23). Finalising the character designs allowed a better understanding when transferring their outline and form into simple 3D shapes. The next part of the process was to incorporate the previously designed 3D shapes and use them as supportive references for the 3D rotoscoping technique to express their physique and body language within 2D animation software.

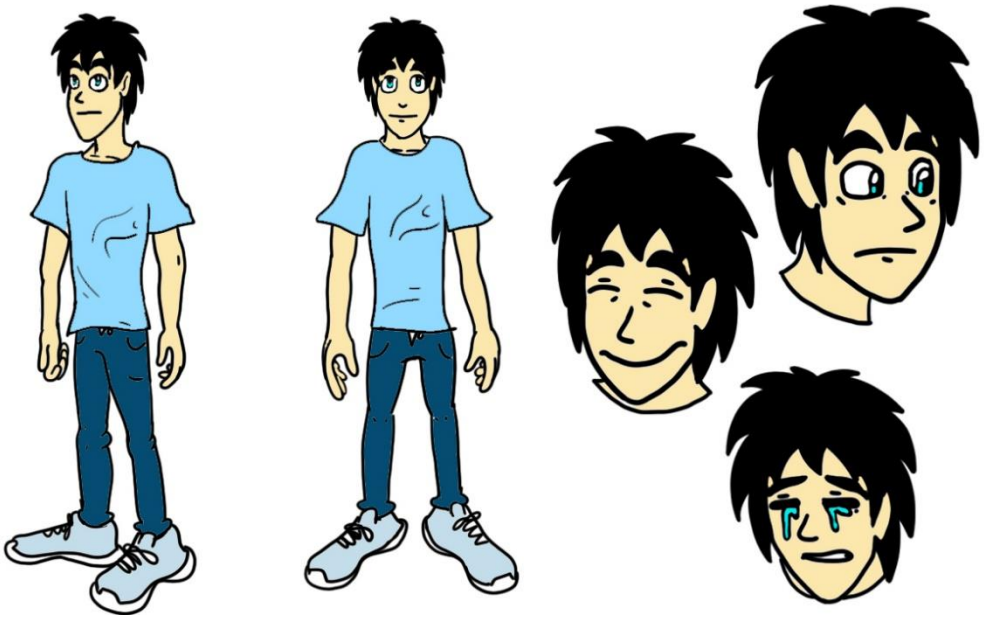

Figure 22. The conceptual design of the protagonist Jack drawn in 2020.

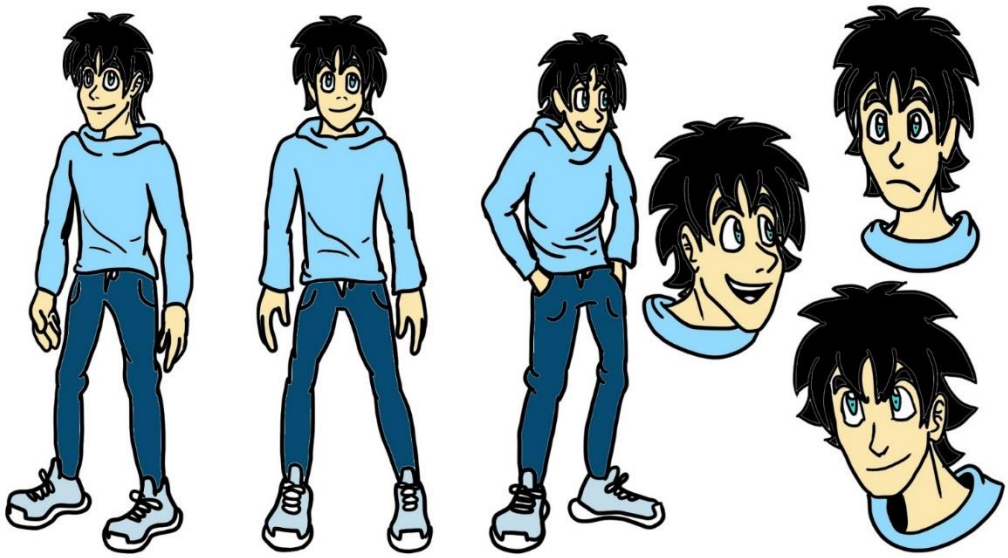

Figure 23. Final conceptual drawings for the main protagonist 'Jack' updated in 2021.

The cast of the animation trailer formed for this thesis consists of stylised human characters that incorporate more unrealistic/fantasy-like designs. Each character shows distinctive visual features, including differences in anatomical proportions and style, as shown in Figure 24. Varying body language rules must be applied as not more than one person operates similarly (Beiman, 2017) to execute each character's structured movement and visual language accurately. Using 2D characters that differ in proportions and designs will require the creation of specific 3D shapes. Each shape corresponds to the distinctive character model when applying the 3D rotoscoping technique. Creating particular 3D shapes for each character can support the overlapping of 2D animation and allow it to fit the varying physiques and visual character complexities. According to (Jones & Oliff, 2007), it may be difficult to uphold and retain the charm of 2D animation when combined and introduced into a CG world. Jones and Oliff also suggest an alternative, but it would require an experienced modeller with a creative eye to replicate and transfer the 2D character into a 3D format

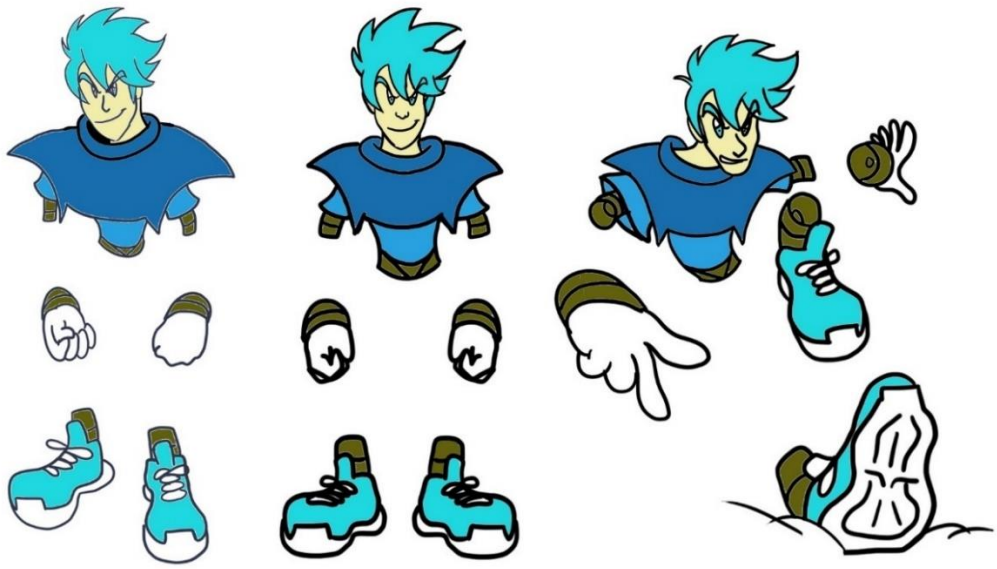

Figure 24. Finalised conceptual drawings of Jack's chosen video game champion.

The technological aspect of modelling and rigging 3D models to a high standard is unnecessary to form a successful 3D reference. Using basic 3D models to represent 2D characters accurately can technically benefit aesthetic choices depending on what the animator/director requires (O'Hailey, 2010). It is argued that hand-drawn animation is an animator's most personal form of expression (Rall, 2017). Once the 2D characters were finalised, I tested and traced them over three different mediums: Live-action, Motion Capture, and Keyframe Animation.

4.2 Live-Action

A part of this research is to examine and develop a grounding of the process of drawing/tracing 2D animation over live-action references and its creative outcome. As a starting point, I recorded myself on my phone, imported the footage and applied it to a 2D animation software (in this case Adobe Animate). It is essential in animation to follow real-life references, not to the bone but to help create a refined essence of movement through the visual exploration to validate the motion of a person or object (Besen & Hallett, 2008)**.** I followed the traditional rotoscoping technique for the first live-action test and traced my chosen 2D characters on top. The next step was to capture the real-life motions of the actor (myself) and transfer the captured movements onto the 2D character. Within this process, it is crucial to focus on animation assistance and apply the use of references to help implement the required

principles of animation to develop stylised movement. Although a real-life actor forms the base foundation for the motion and poses, it can be modified through drawings to support more creative actions.

The tests were conducted using rotoscoping animation in its literal form, i.e. drawing frame by frame over the human actor and creating a realistic sense of movement (Figure 25).

Figure 25. Footage of myself performing a punch and rotoscoping/tracing over my movements with my 2D character.

However, this perspective can be problematic as the actor's realistic human qualities have expressive limitations, which restrict the principles of animation and creative control of the stylised 2D characters. The use of rotoscoping makes the 2D animation itself seem under-animated and gives a sense of an unbalance between the stylised character's design and the human actor's realistic nature.

By relying on live-action references, the 2D animation will only function as well as the human actor (Osborn, 2016). Pushing the stylisation of the movement/poses will better fit the overall design, expressions, and visual language of the 2D characters. The use of tracing can potentially shape my stylised characters but should not be overly reliant on the references but understanding the breakdowns and makeup of each

character and how they would function through their specific emotions and by giving them personalities.

4.3 Motion Capture

Motion capture or performance capture is recording motion data from a live performance and transferring that movement onto a 3D character rig (O'Neill, 2015). This animation medium allows the ability to import live-action references into a digital format.

4.3.1 Failed Test

While first experimenting with motion capture, the addition of 3D rotoscoping was applied to a used mocap-driven 3D character, executing a front profile punch shown in Figure 26. Once I finalised the shot, it was playblasted and imported into 2D animation software (Adobe Animate). The first test applied to motion capture used the traditional use of rotoscoping, but through a 3D actor reference shown in Figure 27, this helped (but not entirely) drive the stylised 2D character's movements.

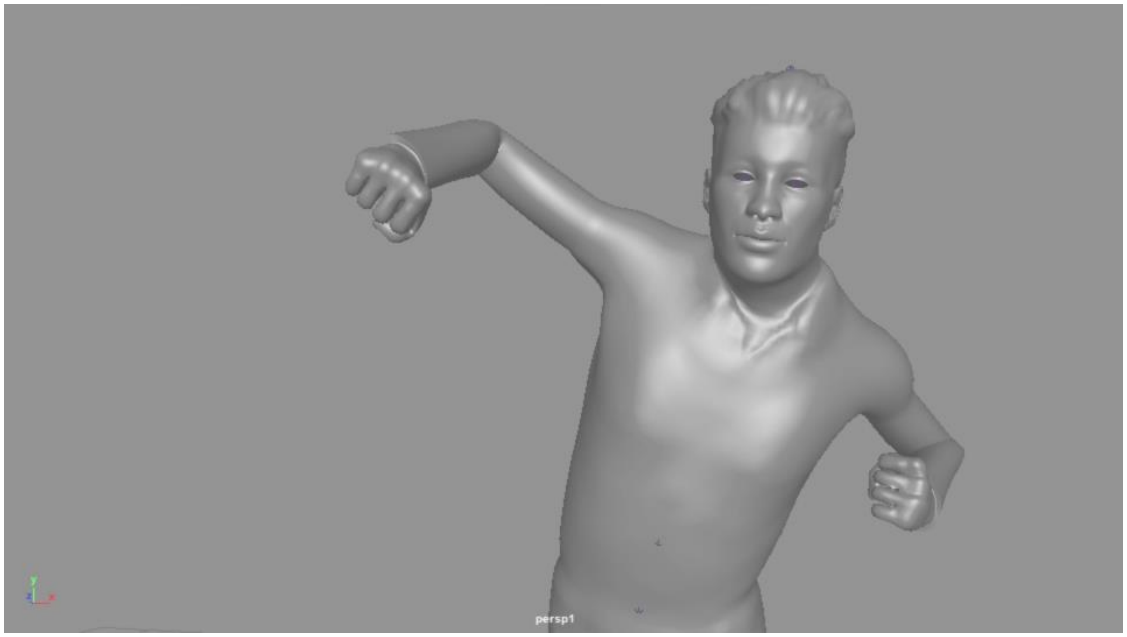

Figure 26. 3D character driven by motion capture performing a punch.

Figure 27. My original 2D character rotoscoped over the mocap digital character.

The test shown in Figure 26 and Figure 27 shows over-reliant use of the rotoscope technique and its application when applied to the 2D character, requiring a sense of separation from the base animation (the mocap actor). A solution to avoid copying the reference is to work beyond it. Adding a more creative interpretation will show more expressive actions and movements that can convey the character's demeanour. However, establishing a human-like 3D rig as the base reference for a stylised 2D character can cause issues while tracing the movements of a mocap image. Generating visual drawings of 2D characters based on 3D references that displayed different physiques and designs posed some difficulty.

By rotoscoping a 2D character and completely copying the movement of the base reference, the character itself may lack a sense of life that the animator could have expressed (Milne, 1998), limiting how rotoscoping can be used. Although this technique has shown creative boundaries, it can still be successfully used to capture a character's perspective from different angles from the initial reference.

The later tests used mocap data from Mixamo, an online website with a variety of ready-to-use mocap files displaying a collection of human movement through custom characters that anyone can access (Mixamo, 2015). Figure 28 shows a mocap actor from Mixamo imported with mocap data, while Figure 29 shows the same mocap file but modified through animation layers.

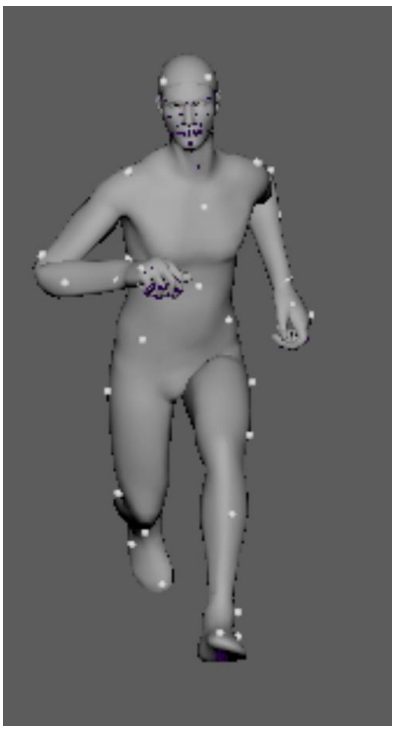

Figure 28. Imported mocap File from Mixamo untouched.

Figure 29. Adjusted the motion of the character via animation layers in Maya.

Suppose the CG live-action references express a more vigorous activity throughout development. In that case, it still won't be possible to generate exaggerated movements of stylised characters because as a guide, they are being copied entirely from a realistic source, potentially creating a sense of copying and pasting all of the live-action motions. The repositioning of drawings and timing adjustments can avoid reference duplications and preserve the 2D characters. However, by adjusting the base movements within a 3D software package, it is possible to solve the issue of being too realistic by increasing exaggerated expressions and poses. Using a human character rig to imitate mocap data is problematic because it gives an inaccurate representation of the 2D stylistic character.

Another approach was to experiment with an existing 3D video game model called Rayman, shown in Figure 30, with similar features to my original 2D character. The Rayman model process involved transferring a mocap data file from Mixamo onto the video game model to convey a person running. This test failed because the character's specific identity and design showed an imbalance between the stylised design and realistic human mocap actions. The animation data executing the run cycle was later

shaped to accommodate differing proportions caused by human actions but was unsuccessful. Rayman and my 2D characters share a similar limbless design, but ultimately the characters used will have specific elements and individual levels of complexity.

Figure *30. Screenshot of a Rayman rig created by Gemmygod (2019) being influenced by motion capture data.*

My chosen characters have their specific identities, shape and form, but unfortunately, I couldn't use the Rayman model as a guide to represent their particular appearances. For this test to have a successful outcome, specific CG models must be created to represent the focused 2D characters accurately, interpret them successfully, and generate a more in-depth guide from overlapping 2D drawings.

4.3.2 Successful Tests

Firstly, when preparing for the first successful test, the mocap data consisted of complex parkour/dynamic motions performed by professional actors. Once the mocap data was imported into 3D software (Shown as a visible digital skeleton of the character), I custom-made 3D objects representing my original 2D designs and

attached them to certain parts of the skeletal form creating a rough 3D character template.

The 3D objects are parented to desired locations on the skeleton, where they will stay in their allocated positions while the skeletal form moves within 3D space. The rough 3D representations were entirely influenced by the mocap data displaying closely, but not entirely, the 2D characters finalised concept (shown in Figure 31 and Figure 32).

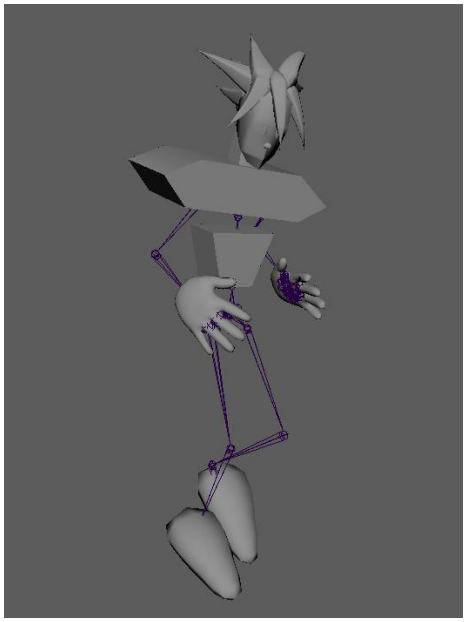

Figure 31. Connecting the 3D shapes of Kevin onto a motion capture skeleton.

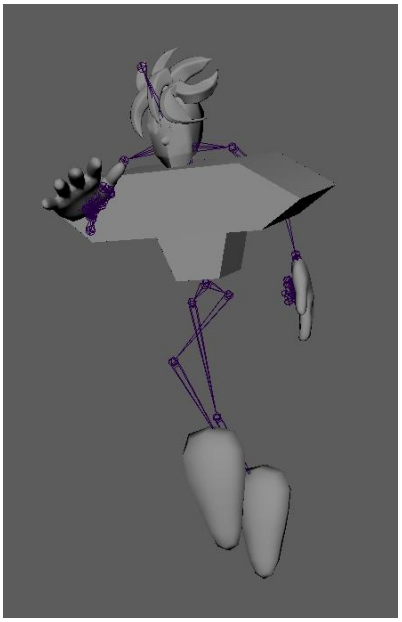

Figure 32. Jack's rough 3D model attached to another motion capture skeleton.

Once the parented 3D objects and the desired camera angle are set, the mocap animation is then playblasted and imported into 2D software (Figure 33). Pencil tests are drawn on top of the playblast footage to break down the potential movement of the 3D characters (Figure 34). These drawn tests helped push/manipulate the poses to fit the stylisation of the 2D content. Once the pencil test movements have been examined, I can combine these rough sketches and angles with the assistance of the 3D interpretations (Figure 35). The CG element is based on the rough drawings to form the 2D character's final look throughout the animated scenes.

The pencil tests shown in Figure 34 lacked the visual clarity of the 2D characters but appeared to focus more on the 3D assets, which expressed sufficient detail of their original designs. The sketches helped generate distinctive movements, and the 3D references provided a base level for production.

Figure 33. Separated 3D reference footage layered on top of each other with the referenced characters being driven through Mixamo data.

Figure 34. Exported onto Adobe Animate as multiple playblasts and pushing the already existing movement via pencil tests.

Figure 35. Made a new layer to make a refined 2D animation based from the Pencil Tests with the assistance of the 3D character designs.

The character's designs presented were easier to develop during the drawing process (due to the accuracy of the models). It was possible with the rotoscoping technique to draw directly over the 3D reference to capture the visual design on each frame. Adjusting the positioning of the drawings afterwards helped me fully grasp the character's actions and prevent the references from being duplicated. The use of rotoscoping/tracing benefitted me through the 3D representation. However, further editing must be required after the character has been traced and copied.

The 2D character's simplistic designs did ease the time constraints, but scenes that included moving 3D camera angles did require more attention towards the 2D forms throughout the changing perspectives. The animation needed more guidance to visually interpret and capture different parts of each character throughout each scene. A technique like rotoscoping needs to be used carefully because it focuses entirely on the references rather than the animations from which it is derived. It is possible that rotoscoping, to some degree, can cause restrictions to the 2D animation if used entirely. Being reliant on the tracing technique can increase time and labour to manually trace the many frames of reference footage (Cartwright, 2012). The realistic interpretation of the human mocap data does clash with the stylistic nature of the 2D characters. Ultimately, developing a more accurate stylised rig and modifying the

actions with pencil tests helped drive the movement, avoiding a realistic human performance

4.4 Keyframe Animation

For the last section of tests, I applied keyframe animation to manipulate body poses to create motion (O'Neill, 2015). The keyframe animation tests are similar to the mocap tests but do not use motion data information, giving me access to a 3D character's body and facial controls to manually bring the character to life with the assistance of references and pencil tests.

4.4.1 Failed Tests

The first step to test keyframe animation involved a live-action reference of myself throwing a punch action. The footage was similar to what is shown in Figure 25 to guide the 3D animation before it was traced to finalise the 2D character's form shown in Figure 36. With the assistance of the live-action reference itself, the character rig could be further manipulated by following the twelve animation principles. Once the 3D animation was somewhat completed, it was imported into 2D software (Adobe Animate) to rotoscope my chosen 2D character on top, eventually covering the rig.

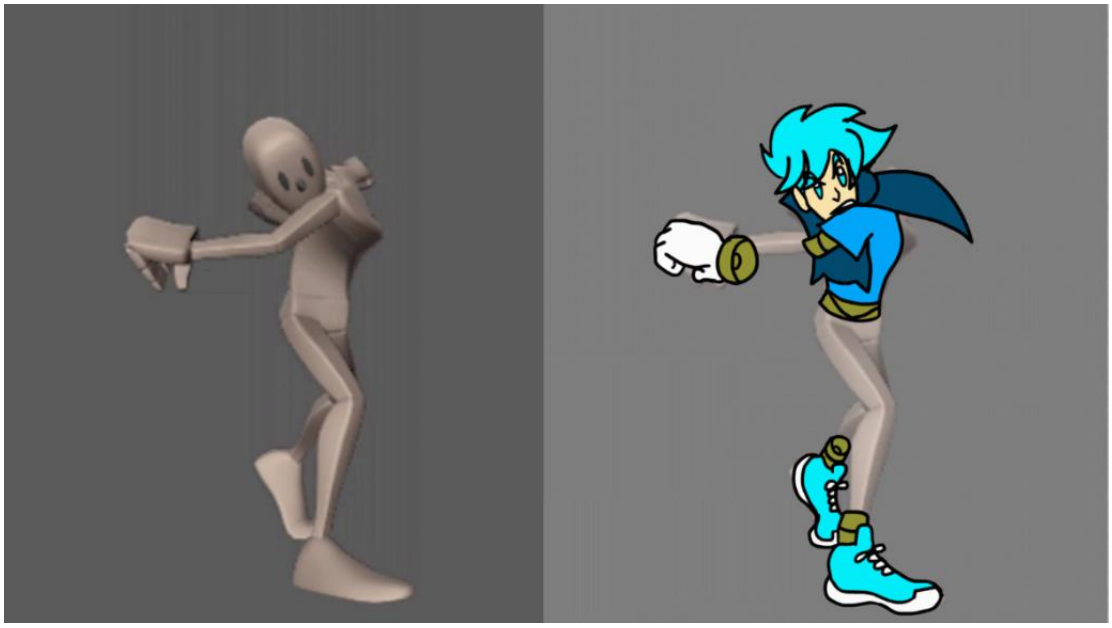

Figure 36. Applying the same rotoscoping technique onto a keyframed 3D model Instead of a human actor.

As a result, the test showed the reference could be heavily affected depending on how its structure is approached. The live-action reference for this test (shown in Figure 25) was expressed without a prop for the actor (myself) to punch, ultimately not capturing the overlapping recoil and movement applied to an object and directing the punch accurately. However, regardless of how the live-action footage was performed, my approach to converting and adjusting the actor footage into a finalised keyframe animation became unnecessarily laborious. In my first attempt at applying my animation skills to push the exaggerated character stylisation, pencil tests were not used, resulting in a negative effect. Once pencil tests were applied to the later experiments to exaggerate movement before animating, it became a helpful and efficient tool.

This test was unsuccessful due to the unnecessary approach to finalising a 3D-based animated character for a 2D reference by following the entire 3D pipeline, including adjustments to animation passes to help develop successful poses and movements (Rodriguez, 2012). Time constraints were in place due to the hybrid animated trailer implementing sections of both workflows (2D and 3D) simultaneously, which would be problematic if followed thoroughly.

Since not all animators will have professional acting performances for inspiration (Giesen, 2017) does not mean the entire keyframe sequence needs to be refined entirely or well put together. The refinements will be shown in the 2D form, and unnecessary to animate perfect CG movements that will not be shown in the final export. This finished 3D animation will not be ideal as two identical refined animations will be created, but only one will be displayed (rotoscope animation).

Considering many computer artists are limited to individual software (Hosea, 2010), it may be efficient to not fully implement the keyframe animation process but only use it to express poses that the live-action reference struggled to achieve (through pencil tests). The methodological framework approach of action theoria helps to break down and evaluate the keyframe animation process. The workflow functions were examined to create a usable representative model as the baseline for my chosen 2D characters.

4.4.2 Successful Tests

To help with the visual interpretation, I made rough 3D replicas of my original 2D characters shown in the animation trailer. The Heroes (Figure 37 and Figure 38), their video game forms (Figure 39 and Figure 40) and the antagonists (Figure 41 and Figure 42). These designs are not entirely accurate to their 2D counterparts as they are only a rough reference used to capture the essence of the character. For each simplistic design, the faces were a unique feature which became the prominent focus. I was more comfortable visually interpreting and converting body proportions from my live-action recordings without needing to create individual 3D torsos.

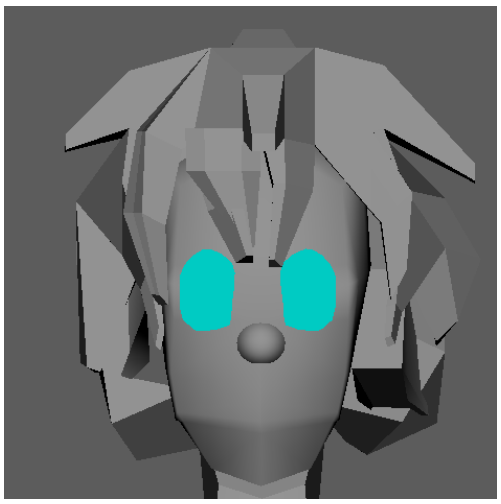

Figure 37. 3D face of Kevin's video game character.

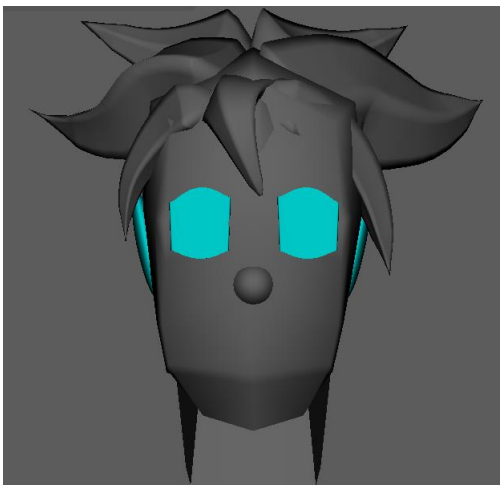

Figure 38. 3D face for Jack's video game character.

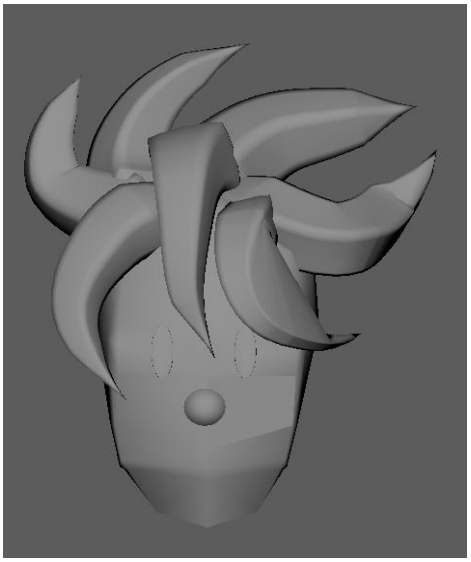

Figure 39. 3D face of Jack's brother Kevin.

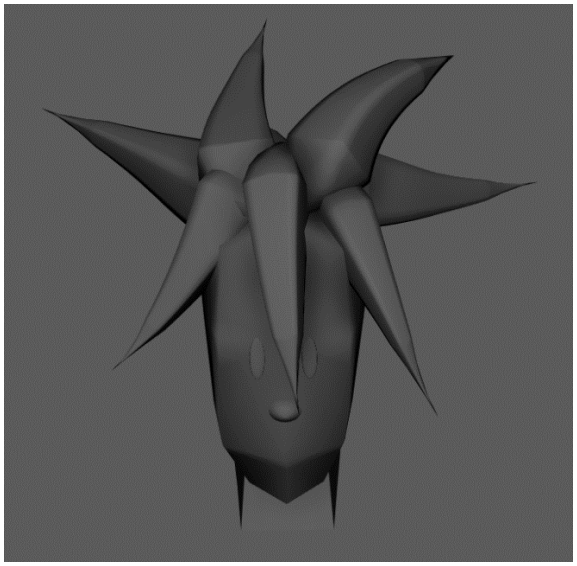

Figure 40. 3D face of the protagonist Jack.

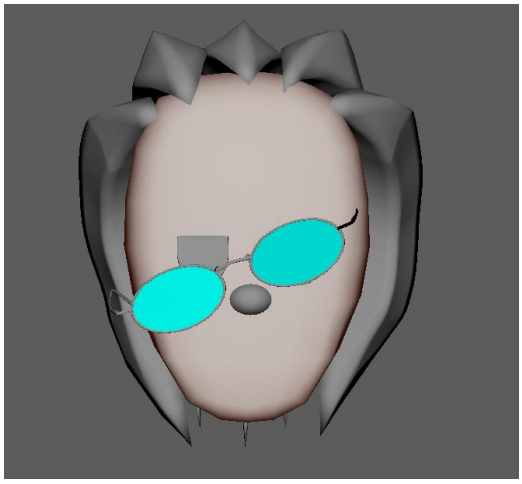

Figure 41. 3D face of the antagonist.

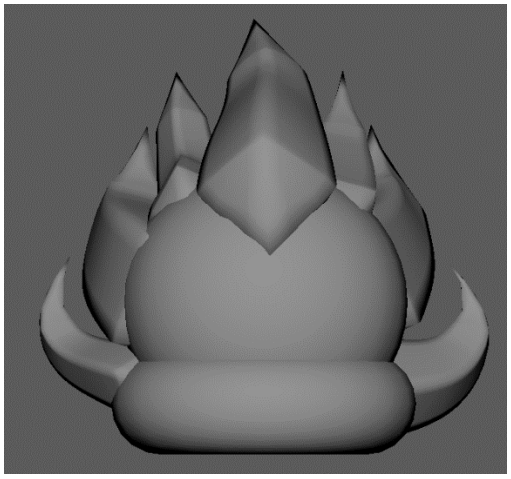

Figure 42. 3D asset representing the face of the antagonists video game character.

Although the 3D characters were formed from basic shapes, there was enough detail to differentiate between the characters while adding enough visual information to develop further refinements to the 2D animation. Once the CG characters were formed in 3D software and used as base references, the drawings were easier to plot by following the accuracy and specificity of the digital model. Although It is much easier to animate with simple character designs (Rall, 2017), this 3D approach can potentially assist one's ideas by expressing a character's varying levels of complexity.

The first approach to using the custom 3D characters as guides involved animating the modelled head of Jack with simplistic motions to imitate similar movements of the pencil tests done before the scene (shown in Figure 43 and Figure 44). Afterwards, the simple 3D actions were established and exported into 2D software (Figure 43), and I could better grasp how to animate the character's body and facial movements throughout the scene.

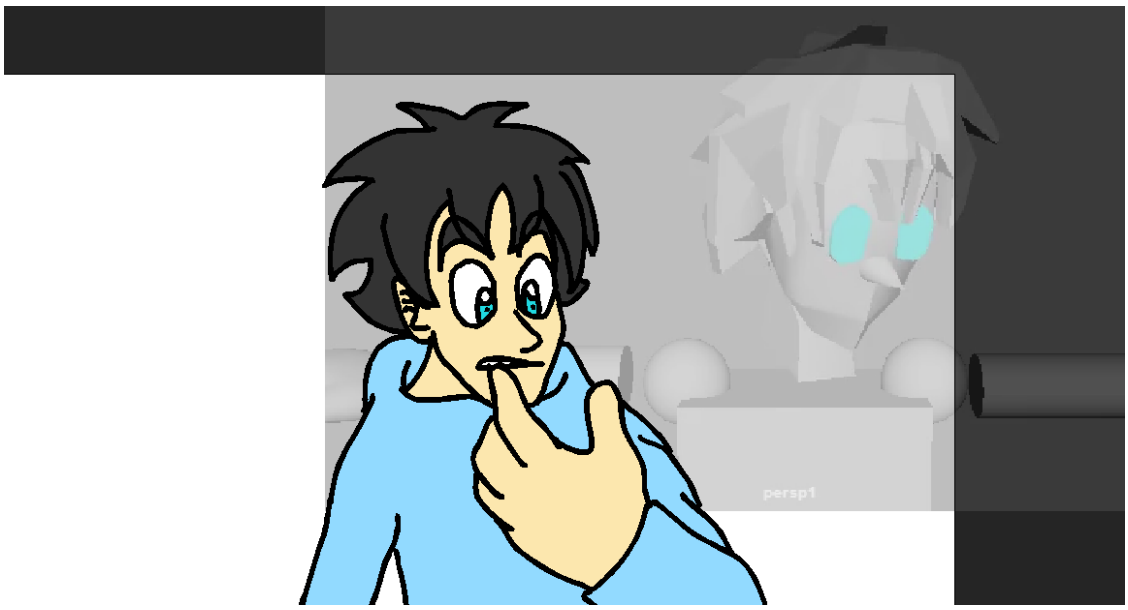

Figure 43. 2D animating Jack with the assistance of the basic 3D reference moving his face.

Following the 3D model in this process allowed me to understand further what a character could look like within that given frame. However, it was difficult to trace a character that did not convey exaggerated movements based on the pencil tests. The scene was mainly based on trial and error in specific areas because the 3D reference did not extend as far as the thumbnails.

Further attention was required for frames that were difficult to draw due to sudden and rapid changes to camera angles and character poses (Figure 44). This test presented its own considerations, such as time differences where the 3D reference was not synchronised to the final pencil tests. The 3D reference helped capture the potential perspective of the 2D character within a given frame, but it would be easier if the reference followed more closely in terms of refined movement.

Figure 44. The generic movement of the 3D asset presenting Jack's design to assist In between frames/drawings.

In the next iterative test, a 3D face was animated over pencil tests as a sequence guide in Maya software (*Figure 45*) to better synchronise the 3D reference with the rough sketches to improve movement. The drawings were layered on top, and the CG model was animated accordingly. The next step was to export the 3D model movements from the character sketches as a playblast and import the preview into Adobe Animate (2D software).

As a result, the 3D reference became more visually accurate and was easier to draw over the model to implement additional exaggerated and stylised motion of the 2D character (shown in Figure 46).

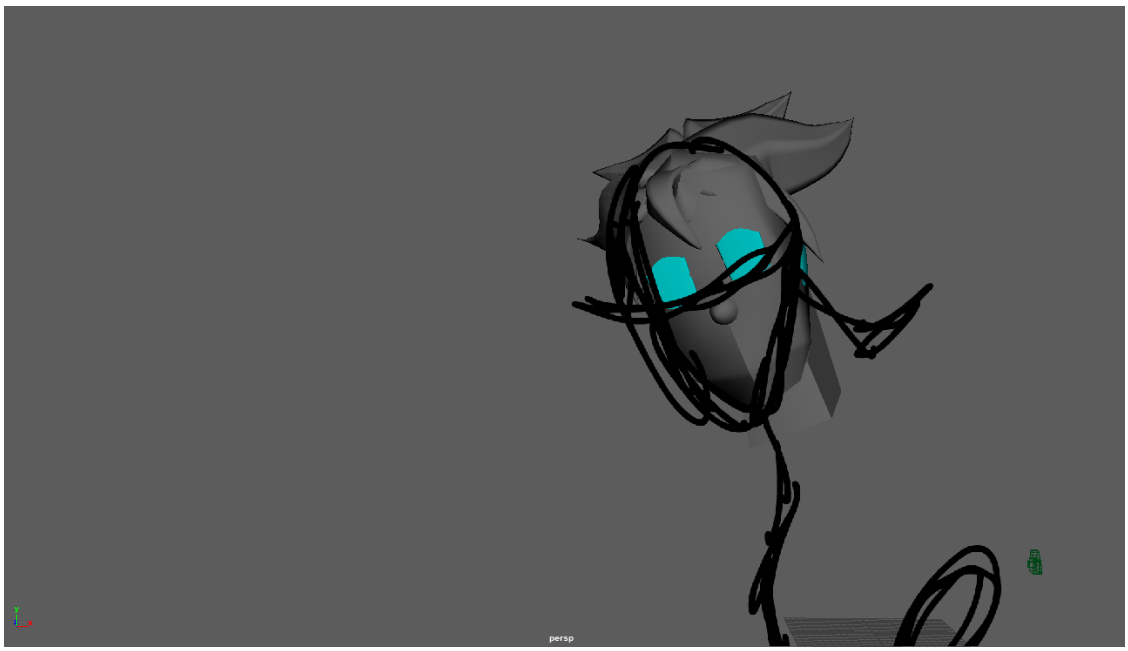

Figure 45. Animating the 3D reference over the 2D pencil tests in Maya.

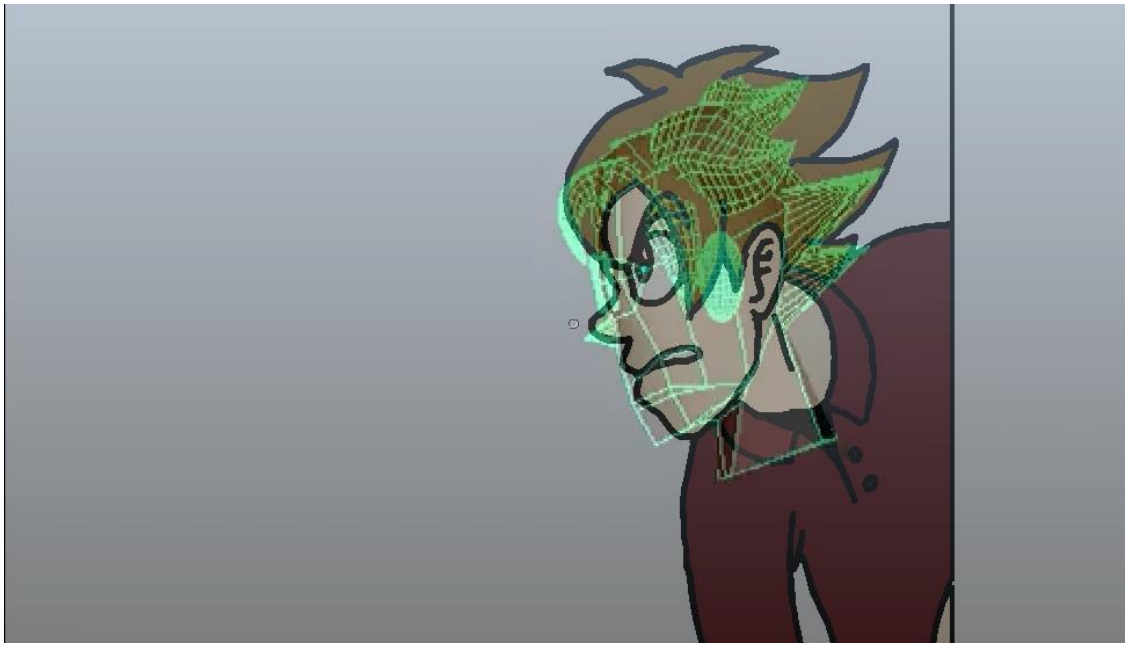

Figure 46. Exporting the rough 3D animation into 2D animation software (Adobe Animate) for the final drawings.

4.4.3 RapidRig: Modular

An alternative method to create a character for keyframe animation that didn't involve mocap data was the application of a Maya plugin known as Rapid Rig: Modular (Nelson, 2013). This application allowed me to create a basic character skeleton and parent 3D objects onto parts of the rig (generating similar poses in the final 2D animation), shown in Figure 47 and Figure 48. Other rigging tools can be used in this experiment, such as the Human IK tool in Maya or equivalent tools in other 3D software packages. However, the module was mainly used as I had previous experience using Rapid Rig. Using this plugin allowed me to follow templates and simplistic tutorials online to generate quick results to save time learning the entire workflow for character rigging. Alongside this test, pencil tests helped capture the character frame by frame as the camera panned around the reference. Achieving a refined model depends on the experience and skills of the animator (Manovich, 2006), the model itself doesn't need to be completed but developed enough to capture the overall structure and design.

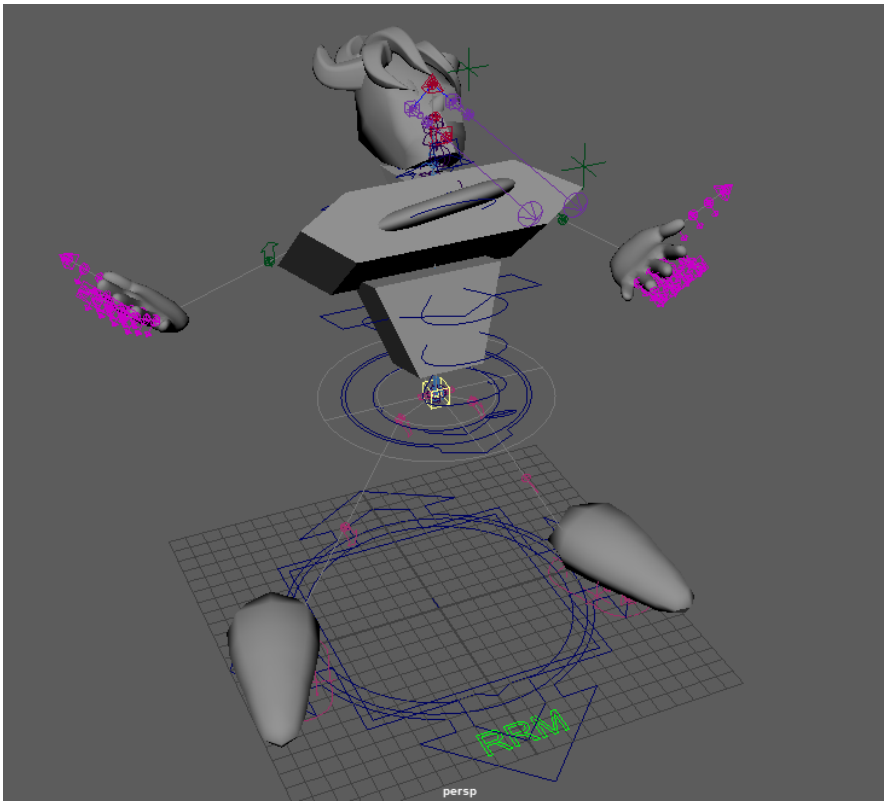

Figure 47. Maya plugin Rapid Rig: Modular test applying basic shapes and attaching them to the generated rig and posing it.

Figure 48. An exported video of the rough 3D rig into Adobe Animate for 2D animation refinement.

Chapter 5 Conclusion

In conclusion, my goal was to determine and explore how effective the use of 3D character references was in assisting and developing 2D animation regardless of movement or perspective angles within my animation trailer.

These experiments involved using various forms of the rotoscoping technique to trace three forms of media: live-action references, motion capture, and keyframe animation. Using the methods proposed in this thesis could enable the 3D animator to visually interpret their original 2D characters accurately by using the rotoscoping technique within a 3D digital format. However, applying the rotoscoping approach to live-action footage established a lacklustre animation due to being reliant on the reference itself becoming lifeless.

Applying rotoscoping elements onto motion capture and keyframe animations during the early stages presented similar results to live-action references. The poses required the assistance of pencil tests (creating rough sketches of a character to push ideas and poses) to enable adjustments to time/positioning. Later in the experimentation, the pencil tests method became an essential guide during the production phase of the 3D animation to generate the finalised 2D movement. Using pencil tests could form the basis of 3D animation and was helpful when expressing the character's actions. To support a more creative approach through live-action, using pencil tests can also be applied, but due to the sketches lacking levels of detail and being shown as rough rather than precise, it was difficult to transfer the human reference onto a stylised character design smoothly with anatomical and proportional differences. However, using 3D references helped provide a more vivid and accurate representation of the 2D character, providing a guide to interpret visual detail, combined with the rough sketches which guided the potential movement.

This thesis explored deeper insights into how creating rough 3D shapes can visually benefit and help interpret a 2D character concept. Introducing these CG shapes onto motion capture skeletons and animation rigs (generated from the Maya plugin Rapid Rig: Modular for this research) was an effective way to achieve baseline 3D movements while featuring the overall look of the 2D character. There is a distinct

difference between using a digital approach and live-action references. The CG format became a digital replacement of the human actor with the desired 3D character replicating its 2D counterpart. Ultimately, the explorations within the different types of media listed showed varying procedures to reach a specified outcome. Appling 3D software helped develop more accurate guidance and visual interpretations for the 2D characters during production and supported the transfer of motion from live-action references.

The use of copying and relying on live-action references limited the creative potential for motion and expressions. As a result, unauthentic 2D animations were produced. Using digital characters to form accurate representations of my stylised 2D characters helped transfer the movements and proportions of the human actor onto the 3D animation.

The case studies in the literature review showed traditional forms of rotoscoping (tracing over the live-action) and 3D rotoscoping elements through various types of 2D/3D software. The successful animation tests enabled the use of rotoscoping elements to be used (to a certain point) as the positioning and timing of the animation needed to be adjusted to avoid the exact limitations of the reference. It was deemed more beneficial if the CG referencing was not entirely copied to expand any creative refinements fully.

The methodological approaches of action theoria and practice-led applied throughout this thesis were used to help focus and dissect my subject matter (character animation) with the assistance of drawing tests and reflections. These methodologies helped examine the pros and cons of the integrated tests explored to validate and answer my research question.

This research revealed that considerably more work would need to be done to determine any future developments and to give opportunities to apply rotoscoping elements to CG assets to improve and successfully drive 2D animation. More information on 3D rotoscoping would help establish greater explorations into developing accurate interpretations of original 2D characters. This technique can support 3D animators of varying 2D skill levels to create successful art forms driven by CG assets with minimal effort. As a result of my findings, I believe that in the future,

this could be a fruitful area for further work and development by applying the rotoscoping technique onto a modernised/digital outlet while incorporating it into motion capture and keyframe references.

References

Adobe. (2015, June 1). Mixamo - Get Animated. Retrieved October 24. 2021, from https://www.mixamo.com/#/ Avenue, A. (2017, April 28). The Making of Snow White - DisneyAvenue.com [Video File]. Retrieved from https://www.YouTube.com/watch?v=a7X8uEjADw&list=LL&index=10&t=1280s&ab_channel=DizAvenue

Animelab. (2016, April 6). My Hero Academia - Official Opening [Video file]. Retrieved from https://www.youtube.com/watch?v=-77UEct0cZM&ab_channel=animelab

Beiman, N. (2016). Animated Performance: bringing imaginary animal, human and fantasy characters to life (Second Edition. ed.). London; New York: Bloomsbury/Fairchild Books.

Beiman, N. (2017). Prepare to Board! Creating Story and Characters for Animated Features and Shorts. United Kingdom, Oxfordshire: Taylor & Francis Group.

Besen, E., & Hallett, B. (2008). Animation unleashed: 100 principles every animator, comic book writer, filmmaker, video artist, and game developer should know. USA, Studio City: Michael Wiese Productions.

Bizat, J. (2017, January 6). Freak of the Week (Freak Kitchen) 03 [Video File] Retrieved from https://vimeo.com/198419914

Blain, J. M. (2021). Blender 2D Animation: The Complete Guide to the Grease Pencil. Milton, UNITED KINGDOM: CRC Press LLC.

Bolter, J. D., & Grusin, R. A. (1999). Remediation: understanding new media. United States, Cambridge: MIT Press.

Bray, R., Fleischer, M. (Producers), & Fleischer, D. (Writer/Director). (1918). Out of the Inkwell [Animation Short Film]. United States: J.R. Bray Studios.

Bruckner, F. (2015). Hybrid image, hybrid montage: Film analytical parameters for live-action/animation hybrids. Animation, 10(1), 22–41.

Candy, L. (2006). Practice Based Research: A Guide. Creativity and Cognition Studios. Australia, Sydney: University of Technology.

Report, 19. Retrieved from http://www.creativityandcognition.com

Cartwright, L. (2012). The Hands of the Animator: Rotoscopic Projection, Condensation, and Repetition Automatism in the Fleischer Apparatus. Body & Society, 18(1), 47–78. doi:10.1177/1357034x11432562.

Classic, T. M. (2014, May 28). A Scanner Darkly (2006) Official Trailer - Keanu Reeves, Robery Downey Jr. Movie HD [Video File] Retrieved from https://www.YouTube.com/watch?v=hkjDUERgCQw&t=9s&ab_channel=MovieclipsClassicTrailers

Davilon47. (2022). Català: Portada principal de Rayman 2: The Great Escape. Own work. https://commons.wikimedia.org/wiki/File:Rayman_2_The_Great_Escape.jpg

Disney, W., Platt, E. M. (Producers), & Cottrell, W., Hand, D., Jackson, W., Morey, L., Pearce, P & Sharpsteen, B. (Writers/Directors). (1937). Snow White and the Seven Dwarfs [Motion Picture]. United States: RKO Radio Pictures.

Du, J. (2021). Comparison Between 3d Animation Design and 2d Animation Design. https://doi.org/10.2991/assehr.k.211120.062

Furniss, M. (1998). Art in motion: animation aesthetics. London, England: John Libbey.

Gemmygod (2019, April 30). Rayman 3D Model. Retrieved February 13. 2022, https://sketchfab.com/3d-models/rayman-7514fb46a34a4d3d8d41f7c7af23e084

Giesen, R., & Khan, A. (2017). Acting and Character Animation: The Art of Animated Films, Acting and Visualizing. Milton, United Kingdom: Taylor & Francis Group.

Gorkab. (2017, August 21). John Lasseter - Where The Wild Things Are (1983)(HD+LD Remaster) [Video File]. Retrieved from https://www.YouTube.com/watch?v=V-EpaPsJe-c&list=LL&index=7&ab_channel=Gorkab

Gourmelen, M. (2016, March 27) Freak of the Week scenes by Maël Gourmelen [Video File] Retrieved from https://vimeo.com/160551385

Guarnido, J. (2014, October 29). Freak Kitchen - Freak of the Week - Official Music Video [Video File]. Retrieved from https://www.YouTube.com/watch?v=y2vzBdIejVY&ab_channel=JuanjoGuarnido

Guarnido, J. (2014, December 10). The making of Freak of the Weak [Video File]. Retrieved from https://www.YouTube.com/watch?v=UQ33WBtOavQ&ab_channel=JuanjoGuarnido

Hanington, B., & Martin, B. (2012). Universal Methods of Design: 100 Ways to Explore Complex Problems, Develop Innovative Strategies, and Deliver Effective Design So. Osceola, UNITED STATES: Quarto Publishing Group USA.

Harris, A. M. (2014). The creative turn: toward a new aesthetic imaginary. Rotterdam, The Netherlands: Sense Publishers.

Harty, D., & Sawdon, P. (2016). Interweaving in hybrid methodologies. Journal of Visual Art Practice, 15(1), 30–40. Retrieved from https://www.tandfonline.com/doi/full/10.1080/14702029.2016.1141559

Hedgehog, T. S. (2018, March 31). Sonic Mania Adventures: Part 1 [Video file]. Retrieved from https://www.youtube.com/watch?v=rDYbwdEn7rs&ab_channel=SonictheHedgehog

Heroderith. (2017, November 12). Cab Calloway & Betty Boop Cartoon Dances | Side-by-Side comparison (Rotoscoping) [Video File]. Retrieved from https://www.YouTube.com/watch?v=_M7S2tjZG_A&t=1s&ab_channel=Heroderith

Honess Roe, A. (2012). Uncanny Indexes: Rotoshopped Interviews as Documentary. Animation, 7(1), 25–37. doi:10.1177/1746847711428851.

Horikoshi, K. (2016). My Hero Academia [Television Series]. Japan: Toho and Bones

Hosea, B. (2010). Drawing Animation. Animation, 5(3), 353–367. doi:10.1177/1746847710386429.

Izani, M., Aishah, Eshaq, A. R., & Norzaiha. (2003). Analysis of the keyframe animation and motion capture case studies. Putrajaya, Malaysia: IEEE.

JaguarMcGuire. (2009a, February 13). SCAD SHort Film - Cat Sequence from "Jaguar McGuire" Dailies [Video File] Retrieved from https://www.YouTube.com/watch?v=jynowNXM1YU&list=LL&index=13&ab_channel=shavingsheep

JaguarMcGuire. (2009b, April 4). 2009 SCAD Short Film work reel presentation [Video File] Retrieved from https://www.YouTube.com/watch?v=0UdrIsrPGMo&ab_channel=JaguarMcGuire

Johnson, P. (2014, June 13). Rotoscoping over 3D Reference [Video File]. Retrieved from https://www.YouTube.com/watch?v=X0taAlZ_MxA

Johnston, O., & Thomas, F. (1995). The illusion of life: Disney animation (1st Edition.). United States, New York: Hyperion.

Jones, A., & Oliff, J. (2007). Thinking animation: bridging the gap between 2D and CG. United States, Boston, Massachusetts: Thomson Course Technology.

Kurtori. (2006, October 12). Where The Wild Things Are - Early DISNEY CG Animation Test [Video File] Retrieved from https://www.YouTube.com/watch?v=LvIDRoO8KnM&t=4s&ab_channel=kurtori

Lee, N., & Madej, K. (2012). Disney stories (1st ed.). New York, USA: Springer.

Lenburg, J. (2012). John Lasseter. New York, United States: Infobase Learning.

Luz, F. C. (2010). Digital Animation: Repercussions of New Media on Traditional Animation Concepts. (pp. 562–569): Springer Berlin Heidelberg.

Macdonald, I. (2016). Hybrid Practices in Moving Image Design: Methods of Heritage and Digital Production in Motion Graphics. Cham, Switzerland: Springer International Publishing AG.

Macleod, K., Beardon, C., & Holdridge, L. (2005). Thinking Through Art: Reflections on Art as Research. Florence, United Kingdom: Taylor & Francis Group.

Manovich, L. (2006). Image Future. Animation, 1(1), 25–44. doi:10.1177/1746847706065839.

Manovich, L. (2007). Understanding hybrid media. Hertz (Ed.), Animated Paintings. San Diego: San Diego Museum of Art.

McBay, W. A., Pallotta, T., Smith, Jonah., Stoff, E & West, P. (Producers), & Linklater, R. (Writer/Director). (2006). A Scanner Darkly [Motion Picture]. United States: Warner Independent Pictures.

McNiff, J. (2013). Action Research: Principles and Practice. London, UNITED KINGDOM: Taylor & Francis Group.

Milic, L., & McConville, Y. (2006). The animation producer's handbook. Maidenhead, England; New York: Open University Press: McGraw Hill Education.

Milne, M. (1998). Entertaining the Future: Real Animators Don't Rotoscope, Or Do They? SIGGRAPH Comput. Graph., 32(2), 5–7. doi:10.1145/282037.565306.

Mingers, J., & Brocklesby, J. (1997). Multimethodology: Towards a framework for mixing methodologies. Omega, 25(5), 486–509. Retrieved from https://www.sciencedirect.com/science/article/pii/S0305048397000182

Miracles, T. (2020, March 18). Rotoscoping Over 3D Animation with Grease Pencil | Blender 2.81 [Video File]. Retrieved from https://www.YouTube.com/watch?v=o6w-oWr-AvA&ab_channel=TeamMiracles

Muratovski, G. (2010). Design and Design Research: The Conflict between the Principles in Design Education and Practices in Industry. Design Principles and Practices: An International Journal—Annual Review, 4(2), 377–386. Retrieved from https://cgscholar.com/bookstore/works/design-and-design-research

Musburger, R. B. (2017). Animation Production : Documentation and Organization. Milton, UNITED KINGDOM: Taylor & Francis Group.

Nelson, D. (2013, October 2). RRM Tutorial 1: Installation. Retrieved April 20, 2022, from https://flippednormals.com/downloads/rapid-rig-modular/

Network, C. (2016, April 21). Adventure Time | Theme Song | Cartoon Network [Video file]. Retrieved from https://www.youtube.com/watch?v=cvDxko2Zm0Q&ab_channel=CartoonNetwork

O'Hailey, T. (2010). Hybrid animation: Integrating 2D and 3D Assets. Burlington, MA: Focal Press.

O'Neill, R. (2008). Digital Character Development: Theory and Practice, Second Edition. United States, Florida: CRC Press LLC.

Osborn, K. (2016). Cartoon character animation with Maya: Mastering the art of exaggerated animation. United Kingdom, London: Bloomsbury Publishing.

Paquette, A. (2013). An Introduction to Computer Graphics for Artists. London, England: Springer London.

Pardew, L., & Wolfley, R. S. (2005). The animator's reference book. Boston, MA: Thomson Course Technology.

Polson, T. (2013). The Noble Approach: Maurice Noble and the Zen of animation design. San Francisco: Chronicle Books.

Rall, H. (2017). Animation: From Concepts and Production. Milton, UNITED KINGDOM: Taylor & Francis Group.

Rodriguez, D. (2012). Animation Methods. U.S.A, California: CreateSpace.

Selby, A. (2013). Animation: Retrieved from https://search-credoreference-com.ezproxy.aut.ac.nz/

Simon, M. (2003). Producing Independent 2D Character Animation: making and selling a short film. Amsterdam Boston: Focal Press.

Syarifuddin, A., & Lucas, T. (2021). Exploring 3D Playblast-To-2D Animation Rotoscoping Techniques. Trends in Undergraduate Research, 4(2), 1–13. doi:10.33736/tur.3499.2021.

Ubisoft. (1999). Rayman 2: The Great Escape [Video Game]

Ward, P. (Producer). (2010). Adventure Time [Television Series]. United States: Frederator Studios

Ward, P. (2006). Some Thoughts on Practice-Theory Relationships in Animation Studies. Animation, 1(2), 229–245. doi:10.1177/1746847706065845.

Ward, P. (2012a). Independent Animation, Rotoshop and Communities of Practice: As Seen Through A Scanner Darkly. Animation, 7(1), 59–72. doi:10.1177/1746847711428852.

Ward, P. (2012b). Rotoshop and the Work of Bob Sabiston. Animation, 7(1), 5–6. doi:10.1177/1746847712438955.

Webster, C., & O'Reilly. (2006). Animation the mechanics of motion. Focal Press visual effects & animation (pp. electronic text.). Retrieved from https://virtual.anu.edu.au/login/?url=https://learning.oreilly.com/library/view/~/9780240516660/?ar

White, T. (2006). Animation from Pencils to Pixels: Classical Techniques for the Digital Animator. Oxford, UNITED KINGDOM: CRC Press LLC.

White, T., & Spencer, K. (2013). How to Make Animated Films: Tony White's Masterclass Course on the Traditional Principles of Animation. Burlington, United States: CRC Press LLC.

Winder, C., Dowlatabadi, Z., & Miller-Zarneke, T. (2019). Producing Animation 3e. Milton, UNITED KINGDOM: Taylor & Francis Group.

Appendix A: Link to Thesis Animation Trailer

Airwalker. (2022, June 20). ‘The Final Zenith’ (2022) Animation Trailer | Mitchell Glassie-Walker [Video File] Retrieved from https://youtu.be/DIij_smPkM4